ELECTRONICS Australia

HiFi, Radio & Computers

JUNE 1980

AUST $1.50* NZ $1.60

Build this 300W high-power amplifier module

- Why are the 240V power mains earthed?
- Crystal-controlled TV Pattern Generator
- Simple Electronic Die
- Hee-Haw Siren

Dick proves you don't have to pay through the nose to get good tape

Consider the evidence:

– Our tape comes from a substantial manufacturer of bulk magnetic tape. This manufacturer is virtually unknown (compared to the big guys) but he turns out a tape of great quality and consistency. The tape is sold to companies all around the world.

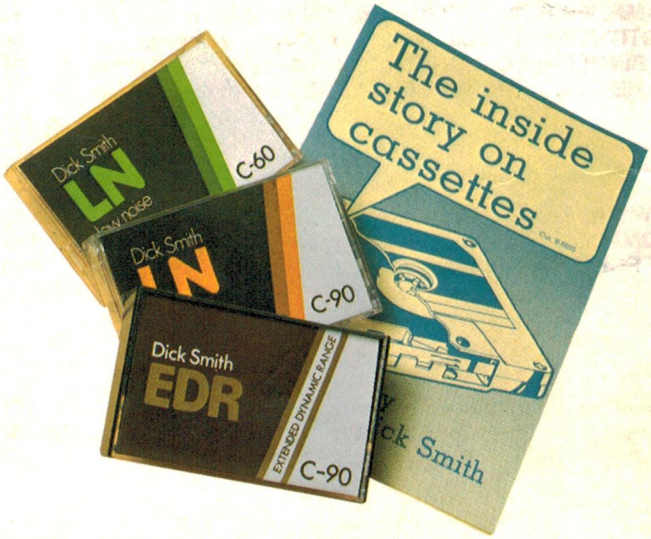
– We take this tape on 'webs' (large rolls) to our overseas factory. There it is tested, slit and assembled into cassette shells manufactured to our exact specifications. The product is tested again, packaged, sealed against dust and moisture and sent to us in Australia

– But the crazy thing is, despite the similar quality, we land the tape here for less than we can buy the big name tapes-either here or in Japan!

– After much head scratching we figured it out. The glossy colour ads (like this one-our first and only one) that use expensive models with big boobs in expensive magazines. An excercise revealed that the marketing costs for the big guys tape were staggering!

– At last we had it. But do we have to do the same thing before you believe us!
Do you want us to waste your money like that?

FREE! When you buy 10 or more Dick Smith cassette tapes you will receive FREE a copy of Dick's "The Inside Story on Cassettes" – normally priced at 50¢. This booklet is very informative and will give newcomers and the old hands a new insight into cassettes.



further evidence

The Dick Smith cassette tape is available as a high quality low noise tape for all audio purposes and the fantastic Extended Dynamic Range (EDR) cassette tape for top quality hi fi recordings.

C60LN	Pay only **$1.50** each for 1-9 10 or more **$1.00** each. Cat C-3350
C90LN	Pay only **$2.00** each for 1-9 10 or more **$1.20** each. Cat C-3352
C90EDR	Pay only **$2.75** each for 1-9 10 or more **$1.90** each. Cat. C-3354

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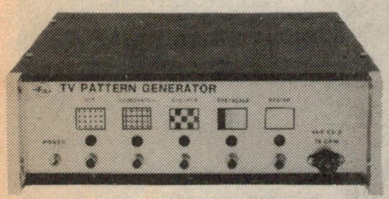
ELECTRONICS Australia

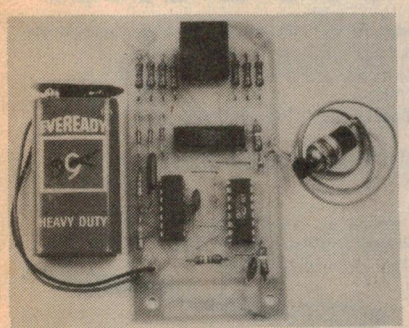
Volume 42 No. 3 **June, 1980**

Australia's largest selling electronics magazine

Versatile TV Pattern Generator



Costing around $50, this new TV pattern generator provides five separate patterns: dot, crosshatch, checkerboard, grey scale and white raster. Build it and adjust your TV for a first-class picture. Full details on p42.



Here's a really simple electronic die. It uses a 7-segment LED readout to display the "throw", runs off a 9V battery, and is assembled on one small PC board. Details on p74.

On the cover

Yes, it's finally arrived! Our new high-power amplifier is capable of delivering a gutsy 300W RMS into a 4 ohm load, yet is reliable and easy to build. Full constructional details start on p54. (Cover design by Garry Lightfoot).

FEATURES

HIFI TOPICS AND REVIEWS

PROJECTS AND CIRCUITS

MICROCOMPUTERS

AMATEUR RADIO, CB SCENE, DX

COLUMNS

DEPARTMENTS

TOMORROW'S TECHNOLOGY IS IN OUR HANDS.

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Whatever you want in the field of electronics, no doubt you want it to happen fast.

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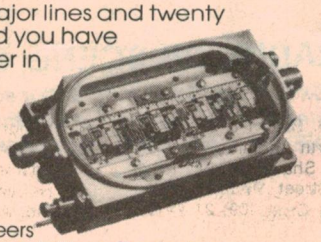
We have world wide technical back-up, on-line stock control, an in-house engineer who is only too happy to offer technical advice and fast service on indent orders.

Team this with large stocks on major lines and twenty years of business experience and you have the quickest, most efficient dealer in tomorrow's technology. GES.



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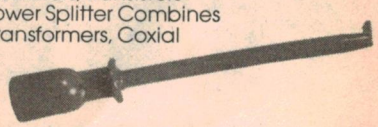
Components Listing

- Microprocessors, Integrated Circuits
- I.C. Sockets - Production - MIL-SPEC Gold & Tin
- Ribbon Cable and Cable Connectors, Edge Connectors
- Kyna/Tefzel Wire 30 AWG, 26 AWG, 24 AWG, - 10 colours
- D.I.L. Switches colour coded. Keyswitches and Keyboards

- Spacers, Terminals - feedthrough - stand-offs
- Heatsinks PCB type and extrusion
- Capacitors - solid tantalum - tag tants - ceramic and film
- E-Z Hooks and Test Leads, Circuit Hardware
- Fuses and Fuse Holders
- Crystal Oscillators, Crystal Ovens, Crystals, Monolithic Crystal Filters • L.E.D. Displays
- Antennas - Microwave
- Amplifiers, Attenuators, Oscillators, Transistors
- Double Balance Mixers, Power Splitter Combines
- Frequency Doublers, R/F Transformers, Coxial Microwave Switches and Waveguide Switches
- EMI-RFI Shielding material, L.C.D. Connectors



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GES/001/CWA

Editorial Viewpoint

Another kind of music . . .

Up till recently, electronic organs were seen as a poor man's version of the real thing. If a pipe instrument was out of the question, one settled grudgingly for the electronic substitute!

Electronic pianos were also tolerated, not for any intrinsic merit but because they were portable. Synthesisers and other audio gadgetry provided musical (?) effects for those who had become bored with the ordinary. And so on . . .

In short, electronics was seen by many as a vulgar intruder in a precinct that rightly belonged to real musical instruments!

But things have changed markedly during the past few years. While manufacturers like Rogers and Allen have continued to develop commendable substitutes for classical pipe organs, many other manufacturers have deflected from this traditional approach. Instead, they have concentrated on producing organs which are entertainment units in their own right, with unique facilities, their own sound, and requiring their own special playing skills. "Organ" has always been a portmanteau term; it is becoming even more so.

Curiously, the Allen Company also produces the RMI Keyboard Computer – an ultra-modern portable accompaniment instrument that can be anything from a synthesiser, through a whole range of orchestral instruments, to a classical organ sound-alike. Instruments like this make available to groups sonic resources which they could not otherwise enjoy.

Electronic pianos, too, have ceased to be a poor man's substitute for the real thing. No one suggests that they rival an imperial grand for traditional literature but they are used – often alongside an acoustic instrument – for their own unique properties.

In saying all this, I am not trying to perpetuate the old argument about acoustic instruments versus their electronic counterparts. What I am saying is that such argument is becoming irrelevant.

Acoustic instruments have traditions, qualities, connotations and literature that no true music lover would deny. To imitate those sounds electronically is an interesting challenge and, for many of us, the opportunity to imitate is better than no opportunity at all.

But to regard electronic music as purely imitative is to miss the whole thrust of what is happening around us. Non-traditional electronic organs, pianos and other instruments, synthesisers, sound processors, amplifiers and whatnots have emerged as musical sources in their own right. And they're not about to go away.

We will end up with a very one-eyed view of the modern music scene if we reject electronic sound – simply because it isn't something else!

Neville Williams

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Postal Address: PO Box 163, Beaconsfield 2014.

Advertising Offices
Sydney — 57 Regent St, Sydney 2008.
Phone (02) 699 3622 Telex 25027
Representative: Narciso Pimentel.

Melbourne — 392 Little Collins St, Melbourne 3000. Phone (03) 602 3033
Representative: Janis Wallace

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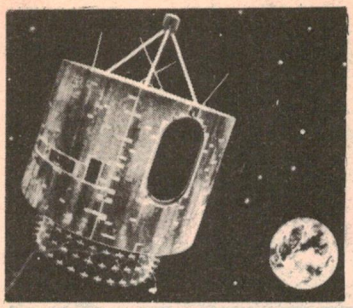
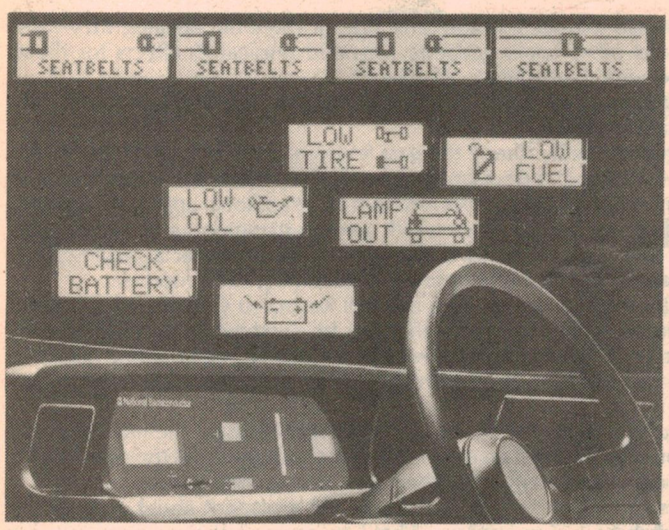


News Highlights

New car instrument panel: speech synthesis & LCDs



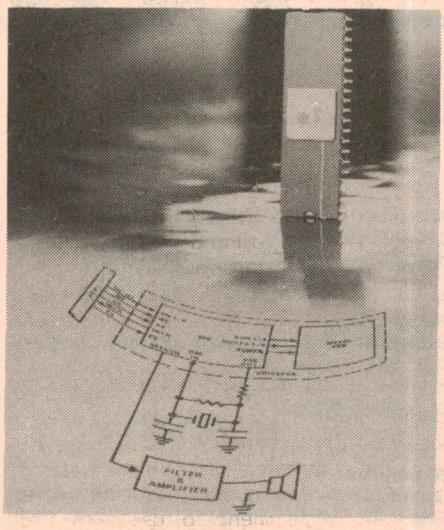
Liquid crystal displays and speech synthesis combine to give visual and audible warning messages from this new instrument panel.

Santa Clara, CA, – A prototype automotive diagnostics warning panel, demonstrating speech synthesis technology and animated liquid crystal displays, has been developed by National Semiconductor Corporation. Shown recently at the 1980 Society of Automotive Engineers Congress and Exposition in Detroit, this speech synthesis system takes inputs from a microcontroller and gives audible warning messages such as low fuel, low brake fluid, door open, fasten seat belts, and others.

The technology of incorporating speech in electronic devices has existed for some time, although previous systems required a large number of components and were very expensive. Through National's recently announced speech processor chip (SPC), it has become practical to introduce speech into the automotive instrument panel as well as a variety of industrial and consumer applications.

The speech synthesis system incorporates National's speech processor and a memory device containing the words or phrases to be spoken. National's technique is to digitise a recorded voice with A/D conversion; compress the code by a factor of 100; store that code in a ROM and play back that word or phrase through the speech processor chip.

Because of customer requirements, all speech synthesis applications using this device are dedicated, custom products. Since the information stored in memory is actually that of recorded speech, the vocabulary can incorporate virtually any word or phrase, including male and female voices or a foreign language.



The new Speech Processor Chip (SPC) can be used in a variety of applications.

IBM reports progress in speech recognition

Speech recognition devices in use today generally use a microprocessor to respond to a small vocabulary of words pronounced very carefully. IBM has been working on a system which will recognise continuous speech without the aid of artificial pauses between words and artificial constraints on the vocabulary, and the company has reported significant progress.

Researchers at IBM have used a 370 Model 168 computer to transcribe speech drawn from a 1000 word vocabulary and read at a normal speaking pace into printed form with a 91% accuracy. The response time so far is in the ratio of 200:1 – a sentence which takes 30 seconds to speak will be processed by the computer and printed in 100 minutes.

However, improving technology and better machine organisation should reduce this response time, and IBM scientists believe that an experimental real-time continuous speech recognition system is a distinct possibility in the 1980s.

Solar power plant for Ayers Rock

The giant US McDonnell Douglas Corporation has announced plans to build a 1MW solar power generating station near Ayers Rock. If their proposal is accepted the power station could be operational by mid-1983.

The solar power station will use a north-facing field of massive movable mirrors to track the Sun and concentrate reflected heat onto a tower mounted receiver. The scheme would include heat storage to allow continued operation at night, and there is a prospect of using the waste heat from the plant's steam cycle to operate a desalination plant to clean up locally available brackish water.

McDonnell Douglas is a pioneer of such central receiver technology and is the prime contractor for a 10MW plant now under construction in California. Australia's first solar power station could be built within 15 kilometres of Ayers Rock, to provide power for a "tourist village".

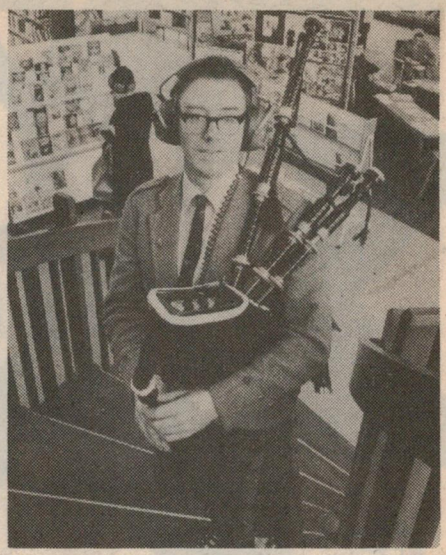
The ultimate use for a microprocessor!

The skirl of the pipes is only heard in this public library by the piper, George Smith, who has combined the age-old sound of the Scottish bagpipes with the latest microprocessor circuitry to produce the world's first electronic bagpipes.

Unlike traditional pipes which can be very noisy and disturbing, especially in the hands of a beginner, the "Keltic Pipes" can be controlled for pitch, volume and tuning electronically. The instrument consists basically of an electronic chanter, an amplifier and a sound box. Headphones can also be attached, so that the player can hear his own music without disturbing other people. Fingering of the pipes' chanter is exactly as for traditional pipes, permitting the beginner to concentrate on fingering without having to master blowing techniques simultaneously.

Basic controls consist of drone sockets, headphones, bass drone tuning, tenor drone tuning, chanter tuning, recharge socket, battery compartment, external amplifier, volume control, balance control, on/off switch, chanter socket and chanter plug.

Interested readers can obtain more information from Mr John Polson, Keltronics Electro-Mechanical-Assembly Ltd, 2-4 Watt Road, Hillington Industrial Estate, Glasgow, Scotland.



Geostationary orbit faces overcrowding

Over-crowding is becoming a problem in outer space. The orbit in most demand, a narrow slot approximately 35,600km above the equator, is filling up, while the demand is steadily increasing.

At a distance of about 35,600km from the Earth the speed of a satellite's revolution matches the speed of the Earth's rotation, so the satellite appears to remain stationary over the same spot. For this reason the orbit is known as "geosynchronous" and eighty operating satellites now occupy the area.

The problem is not so much physical congestion but the saturation of the radio frequency bands used by communications satellites. Satellites using the same frequency must keep at least three or four degrees (about 320 to 400km) from each other, otherwise ground stations cannot discriminate between their separate signals.

Developing nations are now demanding that some of the remaining geosynchronous orbits be kept vacant until they are able to put their own communications satellites into orbit, further complicating the issue.

After a lapse of several years NASA is resuming research into technological solutions to the problems of orbital and spectrum congestion. Future satellites will employ multi-beam antennas, on-board signal processing and switching, and higher power transmitters to make more efficient use of the geosynchronous orbit.

Aust. satellite system scaled down

Plans for Australia's satellite communications system have emerged as vastly less ambitious than originally conceived, following a recent industry briefing. Many of the features which the White task force report saw as the solution to communications problems in the Australian outback have now been discarded.

Instead of a satellite which operated in at least two and probably three frequency bands with a mix of high and low powered transponders, the system will be much less sophisticated. Technical papers presented to the Department of Post and Telecommunications industry briefing in Sydney call for a low-powered satellite operating in a single frequency band. Its major users will be broadcasters, with the ABC accounting for a third of the system's estimated capacity and commercial networks for a third.

The plan mapped out by the Satellite Project Office to achieve direct broadcast differs radically from internationally accepted standards governing the strength of the received signal. The World Administration Radio Conference (WARC) standards call for a signal strength of 62dBW for community reception of direct broadcasts. The Australian system will be designed to operate with a much lower signal strength, probably about 47dBW.

Experiments with the Canadian Hermes satellite system in the outback last year indicated that an acceptable television signal would be possible with 20W transponders, avoiding the high cost and short operating life of the 100W transponders envisaged by the White report.

One of the problems of the plan to broadcast on 11/14GHz is that heavy tropical rainfall will obliterate the signal. Overcoming this problem will make the satellite ground stations much more expensive, and recent reports leave this matter to the commercial users of the system. Failure to solve the rainfall problem will be a serious impediment to users of the satellite data channel, and mining operations in areas like North Queensland now appear to be unlikely satellite customers.

Anti-terrorist radar detects passing bullets

If you're worried about people shooting at you on the street you may be interested in a new device from the British company Racal-MESL.

The company has announced a new radar instrument which uses X-band emissions to detect a bullet passing within six metres of a car and give an audible warning to the occupants of the vehicle. A radio signal is also sent out which can be decoded at a central location to indicate which of several vehicles fitted with the equipment is under fire.

It seems the need for the equipment has arisen mainly in towns, where the high noise level masks the fact that a car has been shot at.

More talking chips

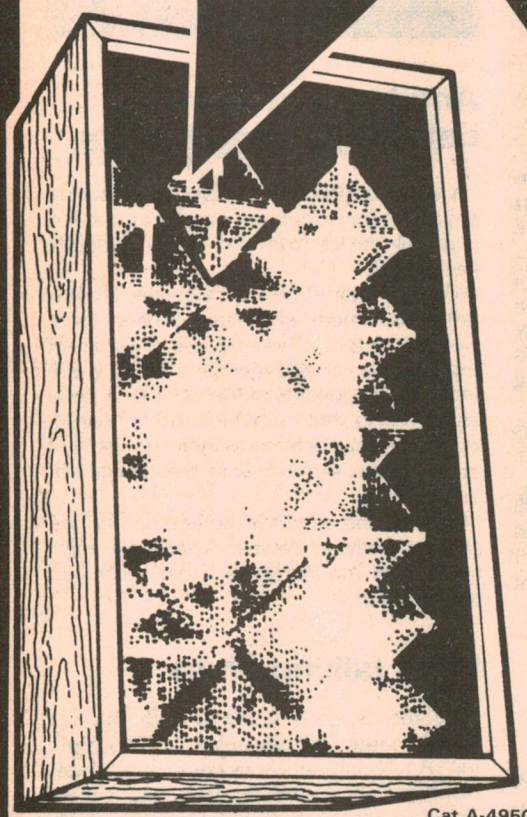
Another speech-synthesis chip set has been announced, this time by Motorola Inc. An N-channel MOS chip set is under development by the company and is planned for release in 1981. Most major US manufacturers have now entered the electronic speech synthesis field, which is expected to feature heavily in the products of the eighties.

Solar powered radio station

A US radio station, WBNO-AM of Bryan, Ohio, is using an array of 33,600 photocells to generate 80% of its power. The power system, designed by MIT's Lincoln Laboratory, stores energy in four Exide UD 466 industrial batteries – a type of battery with the deep cycle-life needed for solar power applications.

Few conventional batteries can withstand the one cycle per day demand of solar power installations and, until recently, this difficulty has limited the applications of solar power.

DISCO COLOUR ORGAN SALE



Cat A-4950

Complete, ready-to-go colour organ housed in attractive wood-grain finish cabinet.

SPECIFICATIONS:
240V operated, 3 channels with 5 colours: Red for low frequencies, yellow for middle, green for upper middle, blue for high and violet for ultra high. Input required: 0.1 watt (it will even work with a transistor radio!) Matches impedance of 3 to 10 ohms. Number of lights: 30 Dimensions: (mm) 460 h x 290 w x 185 d. Comes with instructions and audio connector cord.

We're overstocked on these popular disco accessories – so we've *SLASHED* our prices

Originally, these were selling for $79.50 each . . . Now the price is just $69.50 each – a saving of $10.00!

SPECIAL OFFER!

If you want an exciting display for your home stereo with two colour organs (one for each channel) you can save a massive $60.00 per pair!

THAT'S RIGHT: $99.00 PAIR SAVE $60.00!

Buying by mail? Take advantage of our special *below cost* freight offer: we'll send a pair of these *anywhere in Australia* by road freight for just $6.00. Incredible!

DICK SMITH ELECTRONICS

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	613 Princes Highway,	BLAKEHURST	(Opening Soon)
VIC	399 Lonsdale Street,	MELBOURNE.	Ph 67 9834
	656 Bridge Road,	RICHMOND.	Ph 428 1614
QLD	166 Logan Road,	BURANDA.	Ph 391 6233
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NEWS HIGHLIGHTS

Vending machines accept paper money

Vending machines may soon take your paper money too, following the introduction of the "Ardac Mark 6 Dollar Bill Acceptor" to Australia by Scandic International Pty Ltd.

The Ardac dollar bill acceptor is believed to be one of the most advanced and most widely used paper money acceptors available. It will accept all genuine currency – even badly worn notes – but is able to detect and reject counterfeits, play money and photocopies.

Ardac's note acceptor uses an absorbed radiation technique to analyse both the pattern and the characteristics of engraved currency. An infra-red detector scans the engraving and senses energy reflected by the ink on the note. A genuine note will cause the acceptor to issue a "vend" pulse, but an attempt to defraud will cause the unit to reject the note.

Shortage of silicon — expert warns

An expert materials consultant to the US semiconductor industry has warned that polysilicon, the basic material for the industry, could be in short supply by the end of the year.

Daniel J. Rose, president of Rose Associates of California, puts the problem very simply; the production capability of the 10 polysilicon manufacturers around the world is about to be exceeded by the demands of IC manufacturers. In 1979 total production capacity was about 2765 tonnes worldwide, and this capacity can be expanded by about 10% per year.

On the other hand, the semiconductor industry has been growing by about 30% a year, and even with the economic downturn, growth this year is expected to total 26%. Solar energy programs will also increase the demand for polysilicon as large scale photo voltaic cell manufacture gets under way later this year.

Limited supplies and the inevitable cost increase of polysilicon may mean a slowing of new development work in the industry, and is certain to increase the price of semiconductors.

First satellite for British amateurs

British radio amateurs are preparing to launch their first satellite in 1981. The $300,000 satellite, now under construction at the University of Surrey, has been accepted as a secondary payload on the international Solar Mesosphere Explorer mission to be launched from California in September of next year.

A US Thor-Delta rocket will take the amateur satellite to a height of 530km and place it in a circular polar orbit. The satellite will be the first built by UK amateurs and the ninth in a series of international satellites built by radio enthusiasts. Earlier craft have been produced in Australia, the United States, West Germany, Canada, and Japan.

Optical fibres for MX missile system

The United States Airforce has awarded a development contract to GTE Sylvania Inc for a 15,000km fibre optic communication network to serve the planned mobile intercontinental ballistic missile system, the MX. The network will include approximately 5000 data-processing nodes and thousands of optical repeaters, and will also use high and low frequency radio links. A medium frequency radio link designed to withstand the high radiation levels after a nuclear attack will also be built.

The missile complex served by the communication network will cover a large area of Nevada and Utah, and funding in the long run could exceed $US3 billion. For Sylvania the contract means an intensive recruiting effort, with 600 engineers needed in the next 18 months.

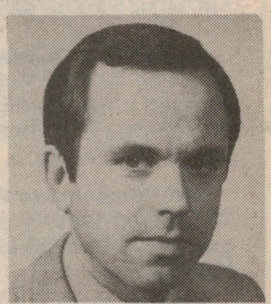
Electronic device for tinnitus victims

Some people suffer from a very uncomfortable complaint called Tinnitus – a constant ringing in the ears – and thus far there is no cure for the condition.

However, a small Canadian Company called Linear Technology has developed an electronic device similar to a hearing aid which may offer relief to some sufferers. The ringing experienced usually has a frequency range of between 1000 and 2000Hz, and the circuit designed by Linear Technology produces noise (presumably white noise) to mask this ringing effect.

Clinical tests of the principle have been carried out and so far the results have been encouraging. Prototype devices will be available later this year.

Dr Sennheiser in Aust.



Bearing a name very well known in World audio circles, Dr Joerg Sennheiser will be visiting Australia shortly. He will be talking in general about the Sennheiser range of audio/hifi products, but with particular reference to the use of infra-red rays for cordless operation of headphones. IR technology has important applications not only for home listening but also as an aid to those with severely impaired hearing.

Born in Bevensen, West Germany in 1944, Joerg Sennheiser studied for his diploma of electrical engineering at the University of Hanover (Germany) and the Swiss Federal Institute of Technology at Zurich. Post graduate work at the latter Institution earned him a PhD in 1973.

Dr Sennheiser became a special engineer with Siemens Albis AG in Zurich but, since 1976, he has been Technical Director of Sennheiser Electronic KG, in Wedemark, West Germany.

His special interests include the field of acoustics, with an emphasis on transducers and allied equipment. He is a member of the Audio Engineering Society (AES), was Chairman of its 59th Convention (Hamburg 1978), Chairman of the North German Section and currently Vice President.

The Sennheiser group is represented in Australia by R H Cunningham Pty Ltd, 146 Roden St, West Melbourne, 3003. Phone (03) 329 9633.

NEWS HIGHLIGHTS

Costs force exodus from Silicon Valley

Major electronics companies in California's "Silicon Valley" are being forced out of the area by rising housing costs and an acute shortage of labour. Two decades of rapid growth in the semiconductor industry in the San Francisco Bay area created "Silicon Valley," the production centre for over half the country's integrated circuits. Now the high cost of living in the Valley has created labour shortages, and major manufacturers are looking elsewhere.

Intel Corporation, National Semiconductor and Hewlett-Packard are among the major corporations looking to the north-west and south-west of the United States for future expansion. Living costs are markedly lower, and labour more plentiful there than in California.

It is mainly production facilities that are being moved, rather than administration or R&D. Boom conditions have resulted in rocketing housing prices, and low wage earners are being pushed out of the area.

A spokesman for Memorex Corporation, manufacturers of computer equipment, quips "It's a little difficult to hire millionaires to work in production," and it seems that millionaires may soon be the only people who can afford to live in Silicon Valley.

Europeans double energy research spending

The European Community Commission will fund energy research to the extent of £530 million (A$1060 million) over the next four years. £211 million of the total will be spent on research on nuclear fusion.

Fusion research will concentrate on the Joint European Torus (JET) experiment that is to be carried out in Britain. Work has already begun on the buildings that will house the doughnut-shaped torus cylinder. Deuterium fuel must be heated to temperatures of over 100 million degrees centrigrade, and contained in the torus by magnetic fields, long enough to achieve the required release of energy by means of nuclear fusion.

The EC program represents more than a doubling of Community investment in energy research, and is seen by many as a big step towards building an economically viable fusion reactor that could produce an abundance of electricity without the problems of nuclear fission power stations.

The major part of the remaining funds will be spent on an experiment, to be carried out in Italy, which will simulate and study the problems of a reactor accident similar to that which recently occurred at Three Mile Island in the United States.

Business Briefs:

Australia's **Chadwick Group** has finalised an agreement with Belling and Lee Ltd of England under which Chadwick will manufacture in Australia the Belling and Lee Ltd range of radio frequency screened enclosures and distribute the full range of Belling and Lee power and signal line filters.

IRH Components Pty Ltd has moved from The Crescent to a recently completed factory and warehouse on Garema Circuit, Kingsgrove. The new address is 53 Garema Circuit, Kingsgrove, NSW 2208 (PO Box 265, Kingsgrove).

AWA (Australasia) Pty Ltd and Thorn Electrical Industries Pty Ltd have announced that Mitsubishi Electric Corporation of Japan will take a 15% shareholding in their jointly owned company AWA-Thorn Consumer Products Pty Ltd. At the same time AWA will purchase a further 15% of the Thorn holding, leaving Thorn with a 20% interest in the joint company.

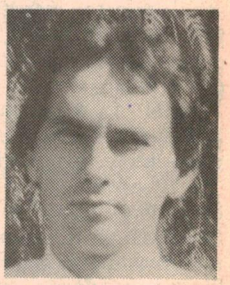
National Panasonic (Australia) Pty Ltd has opened a new headquarters at 95-99 Epping Road, North Ryde 2113 (telephone [02] 887 0144). The new head office replaces the previous agency representation system.

National Semiconductor Corporation has reported third fiscal 1980 sales of $US230 million, an increase of 39% over the same quarter last year, and earnings of $12.4 million, a 59% increase. During the year National delivered the first samples of its 32K MOS EPROM and 256K bubble memory.

Pre-Pak Electronics moves store

After almost nine years of trading from their store at 718 Parramatta Rd, Croydon, NSW, Pre-Pak Electronics Pty Ltd have purchased another property at 1a West St, Lewisham – just a few kilometres away. Managing Director Ian Ralph says that the building has been modified to suit the storage and display of Pre-Pak's wide range of product lines and to suit the needs of a customer self-service establishment. The phone number at the new address is (02) 569 9797. While the former Croydon store has been closed, the mail order address remains unchanged: PO Box 43, Croydon 2132.

New manager for Electronic Agencies



Mr Bruce Routley

Mr Bruce Routley has been appointed manager of "Bill Edge's" Electronic Agencies. Bruce, who has an extensive career in electronic components and products marketing, originally started with General Accessories. From there he went to Edge Electric and, more recently, to Dick Smith Electronics.

Bill Edge said that he was pleased to have Bruce managing the firm, as the two were former work mates at Edge Electric.

IBM, Texas Instruments to market robots

Look for an announcement soon that IBM and Texas Instruments are to begin marketing robots with "sight". Both companies are already using sighted robots on their production lines, and are seeking to capitalise on the growing trend to automation. The robots use television cameras to see nearby objects, and are capable of assembling and manipulating objects on the basis of visual information.

Spotlight on precision.

The Sanwa name has long been associated with high quality reliable test instruments and has gained wide acceptance in many areas including Telecom, military establishments, research, educational, trade and hobbyists. The above represents a selection of some of the more popular instruments from the comprehensive Sanwa power line up.

The "NO SWEAT" Insulation and Low Ω Meter

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- Easy to read wide scale.
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- Optional temperature probe for –30° to 150°C.
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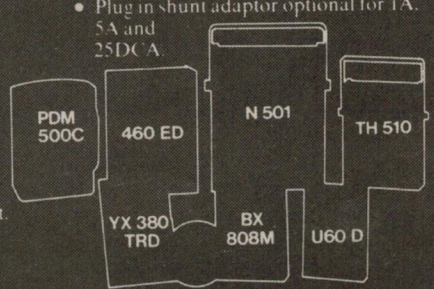

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Handybank — the automatic teller

The introduction of automatic bank tellers by the Bank of NSW is about to give many Australians the opportunity to operate a computer for the first time. But that's not all. The automatic "buck-passers" will also save time and allow a range of banking transactions to take place outside normal trading hours.

by PETER VERNON

"Do-it-yourself banking will represent one of the most revolutionary changes in banking methods since the Wales opened its doors . . . in 1817". Well, that's what the Bank of NSW thinks of its new IBM 3624 automatic teller machines recently installed at selected branches in Sydney and Melbourne.

The Wales calls its new automatic banking system "Handybank", and has initially installed 25 of the machines — 16 in Sydney and 9 in Melbourne — to test the viability of the system and the popularity of the units with the public. Public introduction of the system is scheduled for early May.

By simply pressing a few buttons and inserting a magnetically coded plastic card into the automatic teller, customers will be able to withdraw money, make deposits, or pay off personal loans and Bankcard accounts. The machines will be set into the outside walls of branch offices, and will be available from 7am to 11pm seven days a week, enabling customers to do their banking whenever they wish.

WALES "HANDYBANK" automatic bank teller. Customers can deposit and withdraw money between the hours of 7am and 11pm seven days a week.

Bank customers wishing to use the new facility will first have to obtain special plastic cards, called "Handycards" by the Wales, and a secret personal identification number. After inserting the card and entering their identification number on a calculator style keyboard, users will be able to withdraw or deposit cash and make transfers by pressing the appropriate buttons on the front of the machine.

Cash may be withdrawn in any combination of $5 and $10 notes (up to $200 per day limit) by using a "Change" button in conjunction with a numeric display panel. When the desired combination of notes is shown on the display the user presses an "OK" button and removes his card. The cash will then be issued, together with a receipt.

Customers will be able to nominate either a savings account or a cheque account, or both, for operation through the automatic teller. A user can check the balance remaining in either account by inserting his card, keying in his identification number, and pushing a button marked "Account Balance". A second button is used to select the appropriate account. When the card is removed, the automatic teller issues a printed receipt showing the balance of the account.

Cash transactions should take about 45 seconds — far less than the time usually taken in conventional banking. If the user makes a mistake while pressing any button he can press the

"Correction" button and enter the correct information. Alternatively, the "Cancel" button can be used to clear a mistaken entry and allow the user to start over again.

What about the human tellers? The Wales' chief general manager, Mr R. J. White, says "There will be no reduction in staff requirements or in job opportunities in the bank as a result of the introduction of these machines." Perhaps tellers will find their work more interesting, as routine transactions will be handled by the machines. Certainly the automatic tellers will speed up banking operations and ease the crush in busy banking hours.

People will still be needed to replenish the cash, clear and process deposits, and carry out daily balancing procedures for the automatic tellers. Each machine requires staff support, as all accounting functions other than the automatic withdrawals are handled by human tellers working behind the scenes. Additional staff are also needed to service and maintain the machines.

In a surprising spin-off, the bank has found that the machines provide an excellent training process for new staff. By carrying out the deposit processing and balancing of the automatic tellers, trainees will gain experience in the entire range of tellers' duties while in an environment where mistakes are more easily rectified.

Nevertheless, it seems that the days when banks provided entry into the work force for large numbers of people are coming to an end. It can be expected that the introduction of the automatic teller machines by the Wales is only the first step. Other banks will undoubtedly follow suit, and the total number of job opportunities in banking could well be affected.

The bank is moving slowly, testing every aspect of the operation of the automatic tellers, but it is a scheme with "great potential". Records made by the automatic tellers will be in a computer readable form, able to be stored and processed by the banks' computer systems without further preparation. Although there are no plans to do this at present, it is a possibility for the future.

If linked to existing computer systems the automatic tellers will substantially reduce the human element in banking operations. When considered with the banks' existing on-line computer links and the point of sale terminals in increasing use in retail stores, the era of the "cashless society" may be closer than we think.

It remains to be seen how fast the new technology will be brought into widespread use in the banking industry. The answer probably depends on public acceptance of the Wales' automatic tellers. No doubt the other banks will be watching, with interest.

Language

Recently introduced into Australia, Texas Instrument's talking language translator can actually speak over 500 words and 3000 phrases in English, French, German and Spanish. Modules are also available for Chinese and Japanese. Suggested retail price is around $300. Enquiries to Texas Instruments Australia Ltd, PO Box 106, North Ryde, NSW 2113.

Translation and instant information are just the beginning. New models promise much more, with graphics displays and interfaces to computers. Soon even talking translators will be available.

by BILL HAWKINS

"Want to try a Ramos Fizz?" asked Eliot Hess, a representative for the Craig Corporation, as he pushed a couple of buttons on his hand-held language translator. The display blackened for a moment and then, like a Times Square billboard, began spewing the secret ingredients to a drink I didn't even know existed. Not only did it tell me I needed such things as one-half teaspoon of orange-flower water; it also told me how to mix and serve the concoction.

What business does an exotic drink have in a language translator? Lots, says Hess (millions of dollars of business, in fact), and playing bartender is just one trick these new portable information centres can do.

A translator could plan your next dinner, help you choose a wine, and actually speak to a waiter in his native language to order the meal. It could play chess while you're waiting, teach you a language as you eat — even prescribe medical remedies for the indigestion later.

And that's just the beginning. Now there are new models from which to choose, each with the ability to hold virtually any information you need.

Sure, they still translate languages, but even that's being improved. The newest plans call for increased capability to conjugate verbs, get the proper gender, and even correct syntax through the use of more phrases. But even with advances, language translations are quickly becoming just one of their varied functions.

Recently Craig has been joined by Nixdorf (formerly Lexicon), Sharp, and Texas Instruments, with Panasonic readying a version at this writing. All the translators look and feel like oversize pocket calculators. A keyboard lets you enter your question; a digital display gives you the answer.

But the secret to their ability and what can make each one different is in their programming — the individual instructions and raw data used by the translator's microprocessor.

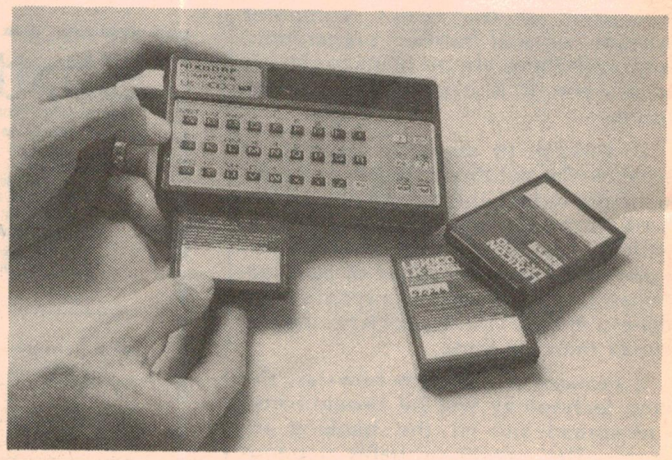
Module mania

Like the plug-in cartridges of a video game, these translators are programmed for a specific function with one or more plug-in modules. While one module may teach it the basics of Italian, another may contain statistics on the Olympic games.

The modules are the key to the versatility of these machines, so manufacturers are in a frenzy to "digitise" as much data on as many different subjects as possible.

For example, besides the bar/wine and diet/nutrition module, the Craig unit will translate Spanish, French, German, Italian, and Japanese literally — and with an additional module, it will display the words

The Craig translator accepts up to three modules at once for cross-translations and phonetic spellings. US price is $200.



Nixdorf unit ($US140) accepts language modules ($US60) or interface connectors ($US150) for attaching it to a computer.

Translators

phonetically, making it easy for you to say them.

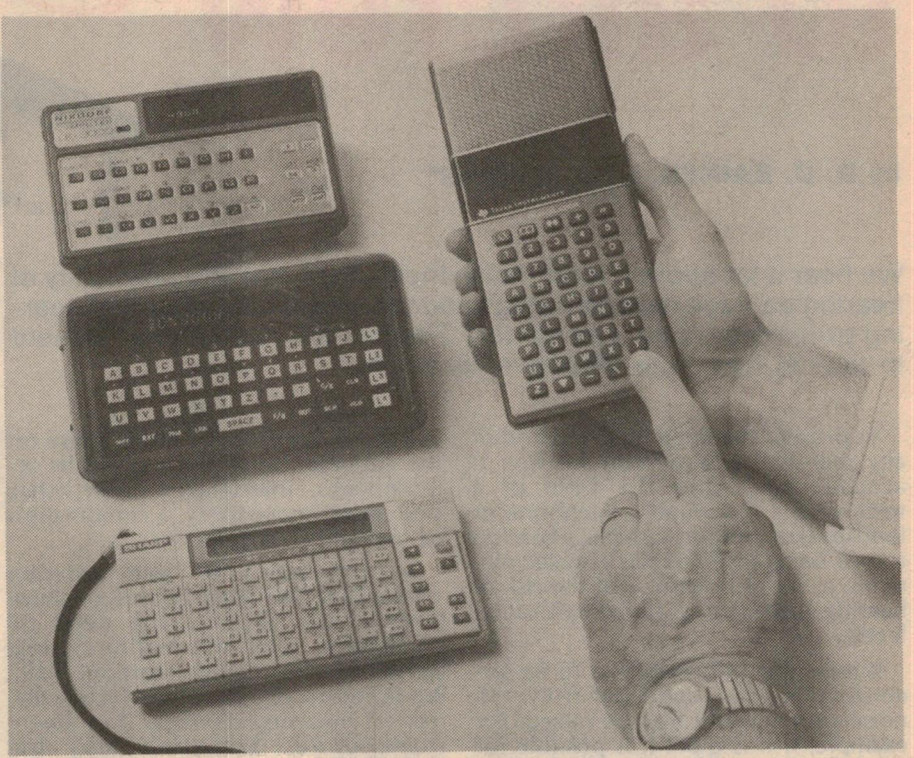
The Nixdorf translator accepts French, Spanish, and German modules, along with data modules that let you add your own information if you wish. Plug in the European soccer-league module, for example, and you can update it yourself at the end of the next ball game.

The Nixdorf also accepts interface modules. These are special connectors that allow you to attach the unit (directly or by phone) to a large conventional computer. For now, on-the-road salespeople, for example, could use this attachment. And not long from now, a quick connection to your home computer could load the unit with an updated shopping list or your daily appointments.

The Texas Instruments' translator also accepts Spanish, French, and German modules, but what it does with them could make you the envy of any linguist: It talks. Each module contains digital information to represent human phonetic sounds. When put together electronically, they become about 300 spoken words that will make up some 3000 phrases.

Now if all this sounds quite incredible, I should tell you that everyone I spoke to emphasised that this is just the start. Future plans from Panasonic, for example, include add-on devices such as a printer or video-display terminal along with educational and game modules.

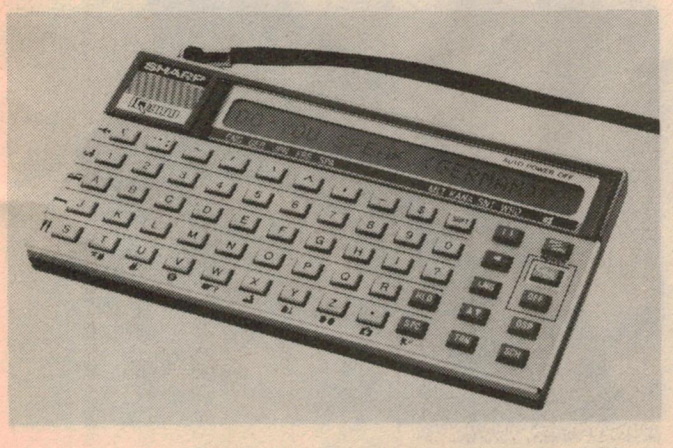
Sharp designers have a speaking translator in the lab, and their present model has a curious dot-matrix display. The designers aren't talking – in any language – but it could display a lot more than just conventional letters and numbers.



ENTER WORDS or phases in one language; get a literal translation in another. Pictured are translators from Nixdorf, Craig, Sharp and Texas Instruments.

At present, the limitation is the memory capacity inside each module, but that's sure to change. Within just the next couple of months, both Craig and Nixdorf plan to switch to a newer, double-density module. For translations, it means more words and verb conjugations. It could mean virtually anything in the data modules.

And what will happen with even higher-density memories, such as bubble technology? "We see it as the ultimate traveller's aid," said a TI spokesman. "And the day will come when you'll simply speak into one end – like a tape recorder. The translation will come out the other."



Sharp's latest translator, the IQ3100, should be available in Australia by July. It will feature modules able to translate from English to Japanese, German, Spanish and French.

The RL-T500 from Panasonic can accommodate up to three memory capsules simultaneously and features an in-built four-function calculator. Unit is not yet available in Australia.

Hearing damage to aircrew

by D. C. BAINES, CEng, MRAeS*

We hear a lot about aircraft noise these days, and the possibility of hearing damage caused by high sound levels. But what about hearing problems inside a jet fighter? The Royal Aircraft Establishment in the UK has done extensive research.

At present the beginning and end of any real-time communications link is acoustic and takes the form of a microphone input and a telephone or loudspeaker output. Greater attention is now being given to this acoustic element, as more is learned of the risk of hearing damage caused by high sound levels.

If incoming information is to be understood it must stand out from any noise with which it may be mixed. For example, if it is quiet it is possible for two people to whisper to each other and be understood, but beside a jet aircraft it may be impossible for them to communicate even if they shout.

The total sound pressure level necessary at the ear for an incoming signal to be understandable thus depends on the overall noise level. This will consist of ambient noise, noise on the communication link caused by atmospherics, interference from other sources or, more likely, a combination of several of these factors.

In the past the sole criterion controlling the total sound pressure level at the ear was the need to understand the information being carried by the communications link. But in recent years a second factor, the risk of hearing damage, has been introduced. The two may be incompatible.

The present British regulations on the prevention of hearing damage impose an equivalent continuous level of 90dBA for eight hours a day for a five day week over 40 working years. Present suggestions are that this should be reduced to 85dBA.

Meters are available that measure the noise dose to which a person is subjected. A microphone detects the noise and the meter assesses and integrates the "A" weighted noise levels, and then gives a readout as a percentage of the stipulated 90dBA for an eight hour dose. If the measurement time is known the equivalent continuous level can be calculated.

To protect the listener from the ambient noise it is possible to put him inside a soundproof booth. While this can be done with static personnel, as in a large steelworks, it is not possible with mobile personnel or in the military situation.

The approach in these cases is to supply a pair of sound attenuating ear muffs and, if the subject is to be part of a communications link, to put earphones in the ear muffs. This is the condition in which all aircrew work and it was therefore necessary to investigate the acoustic conditions inside the ear muffs.

Measurement problems

In early days, conditions at the man's ear were estimated by measuring the

* Instrumentation Advisor, Flight Systems, Royal Aircraft Establishment, Farnborough, Hampshire, England.

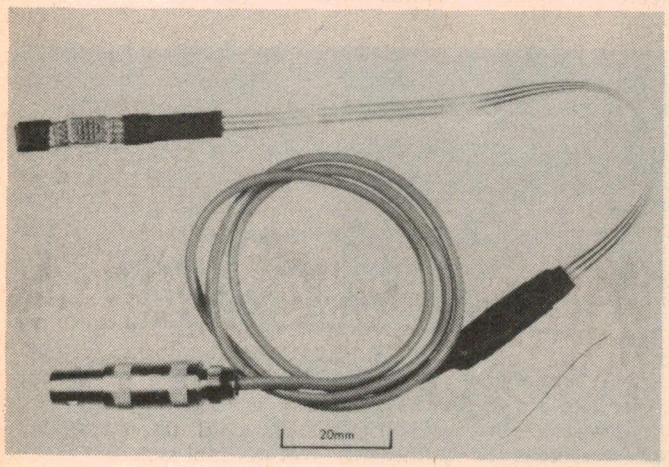


Fig. 1: The miniature microphone assembly developed by the Royal Aircraft Establishment for monitoring sound levels inside an ear muff. The microphone is only 2mm thick.

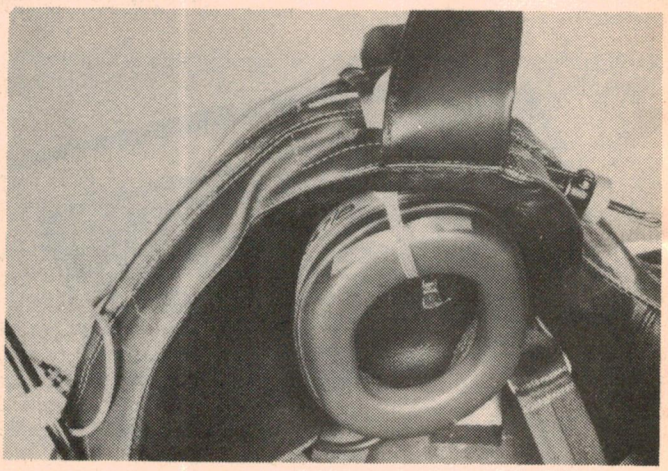


Fig. 2: View showing the microphone fitted to an aircrew helmet. Also visible is the "conditioning" unit (lower left) which powers a miniature amplifier in the microphone case.

ambient noise around his head with a 25 or 13mm condenser microphone. The attenuation of the ear muff was determined in the laboratory and the sound level at the man's ear calculated. This of course took no account of the signal produced at the man's ear by the earphone, and it was also suspect due to variation of the attenuation of the ear muffs — for example due to fit.

Probe microphones were discarded as it was not possible to get the probe underneath the seal of the ear muff without causing serious acoustic leakage. It might be possible to pass the probe through the seal or the hard shell of the muff, but neither would be popular with equipment manufacturers and would be quite impossible with personnel in operational vehicles.

Eventually the assembly shown in Fig. 1 was developed and it meets the requirements admirably. The microphone is a type BT 1759, an electret unit developed by Knowles Electronics (West Sussex). It is only 2mm thick and does not affect the conditions inside the ear muff. It has a ±6dB frequency response from below 100Hz to above 10kHz and a sensitivity of -48dB/Pa. The three core conductor strip to which it is connected is only 0.03mm thick and passes between the seal of the ear muff and the face without causing acoustic leakage.

The four pin plug mates with a connector on a small conditioning unit which supplies the necessary power to the FET amplifier incorporated in the microphone case and matches the microphone to the requirements of the dosemeter. This small unit can be seen in Fig. 2. The lead lengths were determined by the need to connect the microphone to the dosemeter and conditioning unit when they were in a suitable pocket on the subject.

The dosemeters have a calibration position on which a 94dB signal played into the microphone will give a count of 1/sec with a correctly adjusted meter. This calibration is always done both before and after a measurement session and the reading is discarded if the final calibration is not within an accuracy of ± counts. A Bruel and Kjaer type 2203 acoustic calibrator is used. It has an output of 94dB at 1kHz and, as it is a loudspeaker type unit, it is relatively unaffected by the volume of the measurement cavity — unlike a piston calibrator.

The equipment has no affect on the normal duties of the crew member. It is carried on his person so that if necessary he can move around the aircraft. It is not discernable in wear, and all work on the equipment is carried out by the trials team visiting the station.

This equipment has enabled the Royal Aircraft Establishment to obtain noise dose measurements from most aircraft types in the Royal Air Force and the Royal Navy under operational conditions. These include strike aircraft in West Germany, home defence aircraft in the United Kingdom, naval strike aircraft from HMS Ark Royal, and larger maritime reconnaissance aircraft such as the Nimrod and the Shackleton.

RAF Nimrod surveillance aircraft over a Russian helicopter cruiser.

Aircrew trials

The team fits the miniature microphones to the helmets of the aircrew, and a typical installation is shown in Fig. 2. The assembly is held by sticky tape in places where it cannot come into contact with the face and the lead secured to the helmet intercom pigtail so that it is unlikely to be pulled out by snagging of the leads to the dosemeter. A similar arrangement is used for headsets.

With strike aircraft there is no room for a supernumerary. When the aircrew are strapped in and have completed most of their checks a member of the trials party goes up the ladder, plugs the microphone into the dosemeter, switches on the dosemeter and assists the wearer to secrete the dosemeter in a pocket where it will not interfere with his normal duties.

At the end of the sortie the trials party meets the crew and a member of the team removes the dosemeter and takes the reading. When the aircrew are debriefed particular note is made of anything unusual about the sortie. Unusual amounts of intercom traffic and very noisy radio links, for example, could have a bearing on the readings.

With aircraft such as the Shackleton and the Nimrod there is room for a supernumerary and a member of the trials team flies with the crew. These aircraft carry a variety of equipment and crew tasks can be monitored. The trials crewman switches on the meters on engine start-up and subsequently takes readings every hour, noting the duties being carried out by each crewman. The last set of readings is taken on engine shut-down.

Since the factors contributing to the noise dose include the earphone signal, it was decided early in the trials to modify a number of units to allow tape recordings to be made and the amount of communications traffic to be investigated. This involved a minor modification to the conditioning unit and the disabling of the recorder's automatic level control system.

A recorder is shown with the dosemeter in Fig. 3.

The contribution of the communications signal to the noise created

considerable interest when the noise dose readings from the crew of an aircraft that was known to be relatively quiet proved similar to those obtained with some noisy strike aircraft. This was found to be due to the large amount of HF radio traffic necessary during the long periods of time spent by these aircraft outside the range of VHF communications.

Using the 94dB calibrator to put a calibration tone on the tape, these recordings can give readings of the actual signal levels in the headsets and so allow full analysis of the signals.

Frequency identification

Two methods of analysis — third octave and 400 channel narrow band — are used. The former is quite satisfactory where the ambient noise is in general broad band, but the latter allows identification of specific frequencies that may be present in the spectra and that if dominant may need special treatment. Two typical noise spectra are shown in Fig. 4.

Initial findings from the program suggest that only in a very limited number of areas is there any risk of hearing damage, particularly when the short flying life of aircrew is taken into account. However, civilian aircrew fly all their lives and air traffic controllers also use headphones for long periods.

A number of steps can be taken to reduce the noise dose, the most obvious being to reduce the level of ambient noise received by the ear. It is possible, for example, to reduce the actual ambient noise in the cockpit, or to provide for greater attenuation between this noise and the ear.

Work is proceeding in several directions to reduce the ambient noise. One area under investigation is the possibility of reducing the noise of the air blast from cabin conditioning systems. A study of the way in which sound is transmitted from the source — engines, airframe and so on — is also under way.

As a direct result of the ear muff noise investigation a replacement headset with better noise attenuation is being developed for use in one type of aircraft. It is hoped that the ambient noise reduction will encourage the user to lower the signal level at his ear, thus reducing the dose still more.

Signal to noise ratio

Improvement of the signal to noise ratio on radio links could also cut the noise dose figures, because again it could encourage the listener to reduce the overall level. However, it must be admitted that such an improvement must be constant. One bad message will cause the volume to be pushed back to its original level and there it will stay.

If none of these methods can bring the noise dose down to acceptable figures the ultimate answer is to limit the time that a man spends on a job. At the moment, this does not appear necessary in the Royal Air Force but it may be necessary in other environments.

It is hoped that the work and the equipment will be of use to other organisations that have problems measuring and controlling noise dose, particularly where considerable instrument noise is involved. It is worth noting that specifications for hearing conservation — notably ISO RI999/1975 — do not draw attention to the importance of including the communications signal in the noise dose.

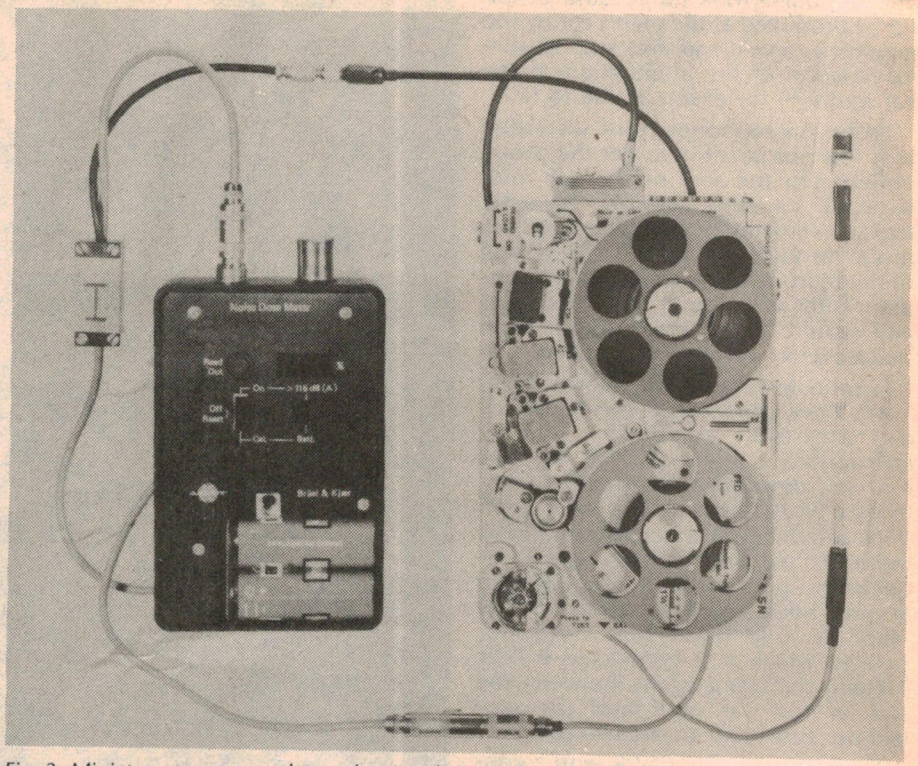


Fig. 3: Miniature tape recorder and noise dosemeter used for the RAF tests. Recording a calibration tone on the tape allows full analysis of signal levels.

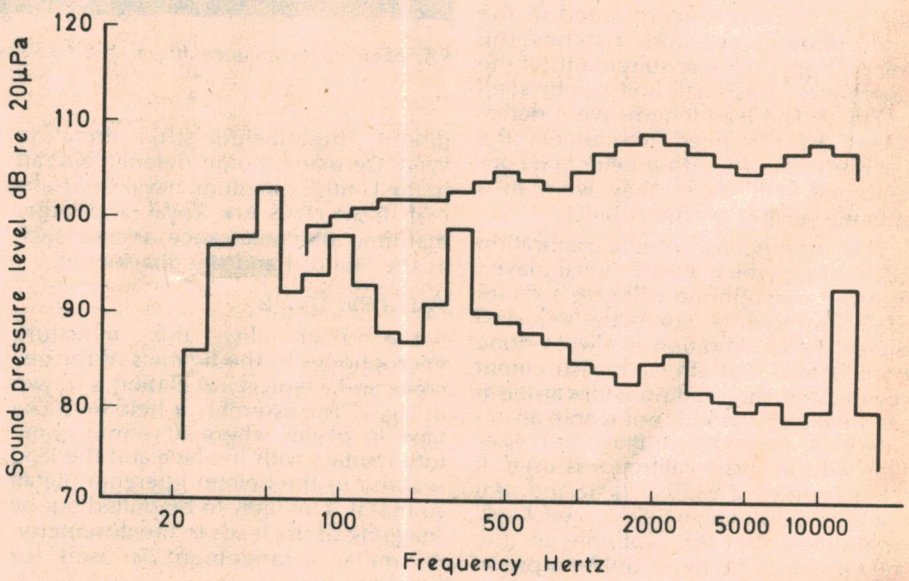


Fig. 4: Two typical aircraft noise spectra taken from RAF tests.

MC68000

Break away from the past.

Motorola's MC68000 sets new MPU system performance standards for the '80s. Now. Motorola announces a new microprocessor so advanced in concept it offers the designer virtually unlimited freedom of system design. Advanced technologies provide it with a speed/power product four times that of standard NMOS. Break away from the past and step into the new era of microprocessors.

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The MC68000 is, by design, perfect for an easy-to-handle, block-structured, high-level language like PASCAL. It simplifies modern programming techniques like modular programming.

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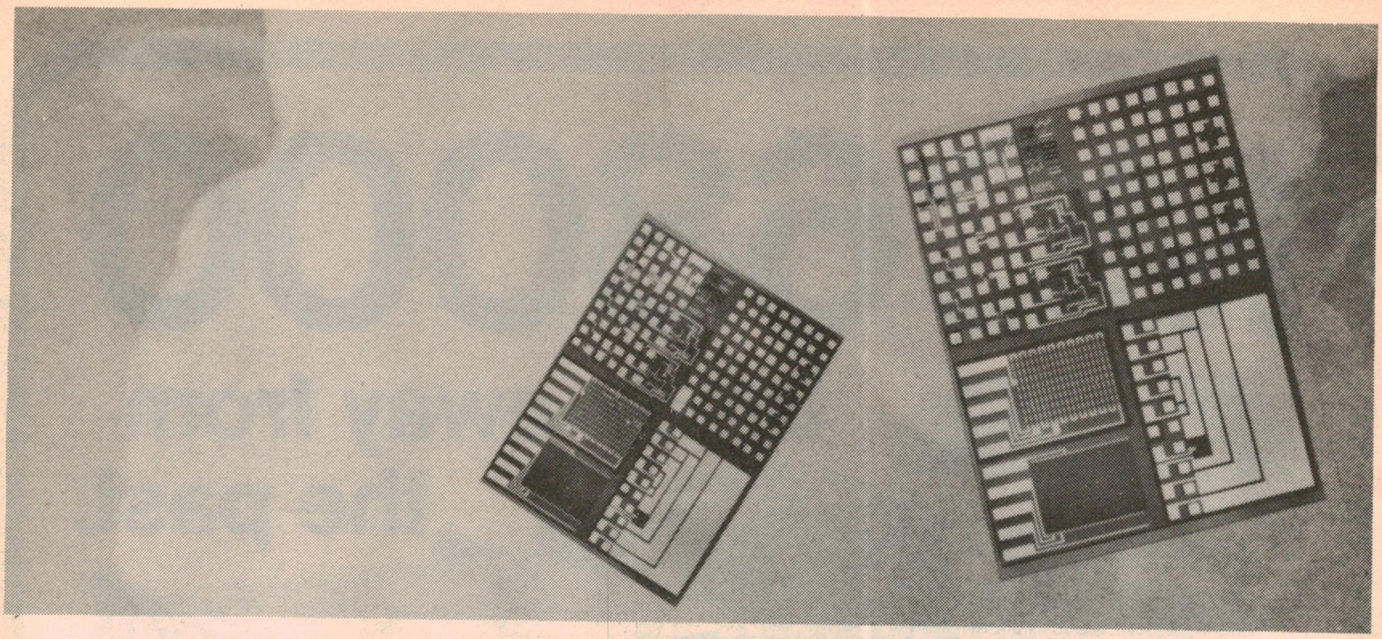
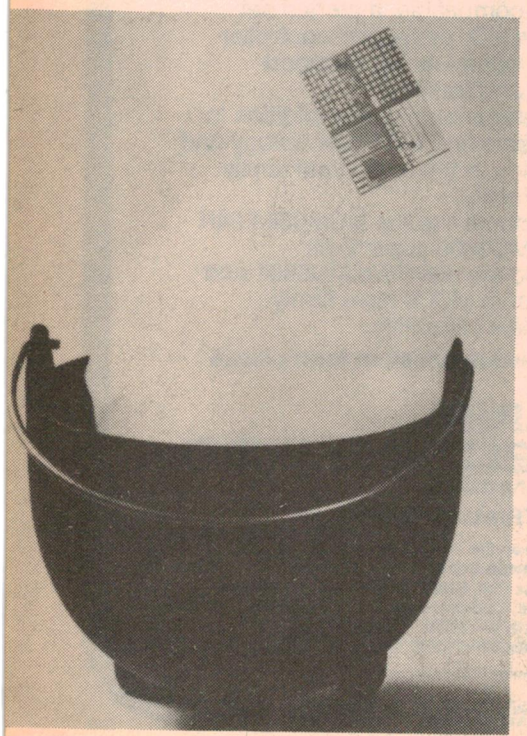
MAS5694



A little less witchery, a little more craft

How do you test a process that makes thousands of ICs an hour, where the placement of a few atoms may be of critical importance? The US National Bureau of Standards is working on the problem and says that scientific methods must replace trial and error.

by MICHAEL BAUM



"At the heart of this, it's really witchcraft, though you may think of it as high technology."

The speaker is Martin Buehler, an electronic technology specialist at the US National Bureau of Standards, and his subject is semiconductor manufacturing – the construction of those miracle chips of electronics that do everything from pacing car engines and human hearts to making computers work.

"You think of the manufacturing process as high technology, but if you were to go into some of the large factories, correcting problems in the production process is more like witchcraft. When something goes wrong, a process engineer says something like, 'Let's try running the furnace a little hotter'."

Buehler and a handful of other specialists in the Centre for Electronics and Electrical Engineering are trying to replace this kind of trial and error approach to semiconductor quality control with reliable methods for testing these tiny electronic circuits.

Semiconductors are a special class of materials that conduct electricity better than insulating materials but not as well as metals. They are used as the basic building materials for microelectronic circuits because of their versatility for channelling electric currents.

The most widely used semiconductor material is silicon, a hard, dark grey, lightweight solid. When used to produce integrated circuits, silicon in the form of a long single-crystal cylinder is sliced into round thin "wafers." By "doping" silicon wafers with tiny amounts of impurities in selected regions, manufacturers can change the electrical properties of these materials with a high degree of precision.

The difference in the electrical conduction of the various doped regions can be used to create transistors or "switches" which can influence the pathways that electrical currents follow through the silicon. These switches can be made to repeatedly turn on and off in a controlled way. When arranged in a special array, the on/off effect of transistors can be used to

mimic the functions of mathematical equations.

The use of such arrays of transistors, called integrated circuits, in the manufacture of electronic instruments and systems has revolutionised the industry. Modern integrated circuits include as many as tens of thousands of circuit elements on a silicon chip about four times the size of a capital "M" on this page. Each of these elements also includes several very thin layers of different materials.

Smaller is Better

Fabricating a piece of electronics with so much in such a small space presents enormous design problems. Often computers are needed to find the solutions. But even a properly designed circuit poses several manufacturing problems as well. The astoundingly small scale of these devices requires production processes which strain the physical limitations of the materials. Even misplaced atoms within the silicon crystal or an unseen speck of dust can hamper the performance of the finished product.

The "wires" used to connect individual elements of each circuit are actually fine lines of metal which are "printed" on the silicon. The width of these lines averages about four to six micrometres, says Buehler, "with some manufacturers pushing two to three micrometres and a few labs experimenting with 1-micrometre widths. The thickness of a human hair is about 60 times the width of a one micrometre line." A small error in the alignment of the photomasks used in forming the "wires" and other elements of the circuit can result in improper or broken connections.

Precise control is also needed when forming transistors with trace amounts of impurities. The phosphorus or boron used to dope the silicon must be correctly placed in exactly the right quantity. Minute variations in the concentration of dopants in different portions of the silicon wafer can ruin the tiny circuits.

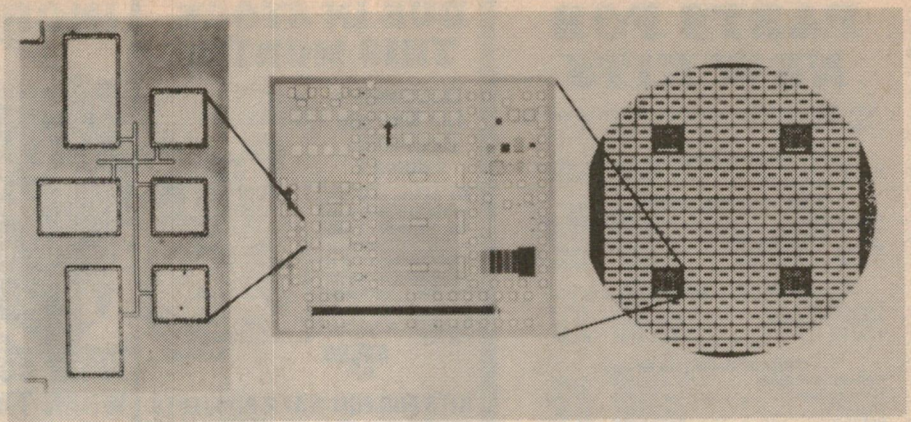
"The impurity density at present," says Buehler, "can be as low as a few parts per million – like sprinkling a few grains of salt on top of a boxcar load of sugar."

All of these fine tolerances are potential sources of trouble in the multi-stage construction of an integrated circuit. (See box for detailed explanation.) And because of the extreme complexity of each integrated circuit chip (some are now the equivalent of a small computer) and their numbers (up to several hundred on a single wafer), individual testing of each chip is an expensive and somewhat futile occupation.

"You cannot," Buehler observes, "thoroughly test these systems."

"Our work revolves around devices and techniques that permit the manufacturer to control the production process, and in that way to assure the quality of the product."

How important is quality control to semiconductor manufacturers? In 1976 a Lockheed official reported in IEEE "Spectrum" that rejected semiconductor components from one supplier were running as high as 68,000 parts out of 106,000 – 64% rejections. Although this is a very unusual circumstance, even the average situation is far from ideal.



The cross-bridge sheet resistor on the left is a test structure used to detect variations in line width. It is part of a test pattern (centre) which includes many other structures. The test pattern appears at regular intervals on the silicon wafer used to make integrated circuits (right).

Test Patterns

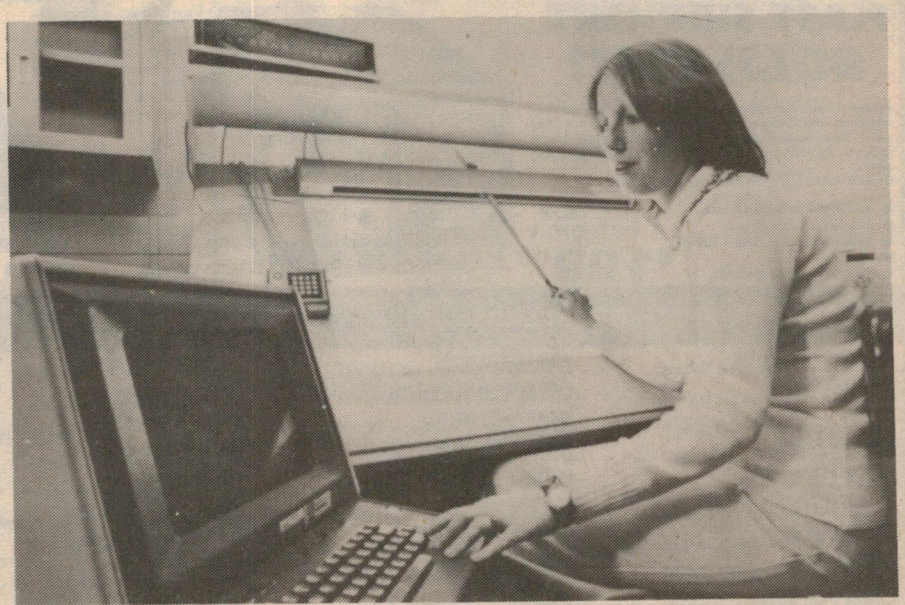
An important concept in the quality control of semiconductor manufacture is the test pattern, an assembly of device-like test structures. Each structure within the pattern is designed to test specific aspects of the process used to build it. In photographs of silicon wafers covered with identical integrated circuit chips, the test patterns are usually easily spotted as small chips of a different design occurring at regular intervals across the wafer.

Test patterns are processed along with the rest of the chips on an integrated circuit wafer and presumably any manufacturing faults which affect the circuits will affect the structures of the test pattern as well.

An example of an NBS test structure is the cross-bridge sheet resistor (see Photo, this page). This particular test structure, which takes the form of an elongated cross, appears on the photomask used to "print" a particular layer of the integrated circuit wafer. The cross-bridge sheet resistors are designed to test for variations in the line widths of the many conducting layers of the circuit.

Other test structures with varying degrees of complexity measure such factors as the alignment of different photomasks, the densities of dopants in the silicon, and electrical characteristics of the circuit elements.

You need measure only a few quantities to get all this information, according to Murray Bullis, head of the NBS Electron Devices Division. "We're measuring basically four things: voltage across two



Kerry Fischer of the NBS semiconductor processing facility uses a digitiser which converts a test design into a set of co-ordinates stored in computer memory.

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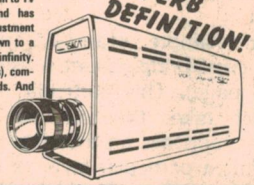

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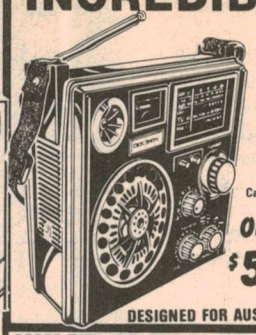

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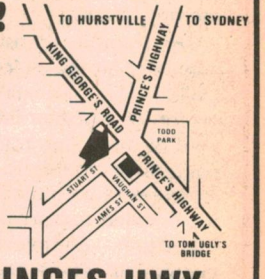

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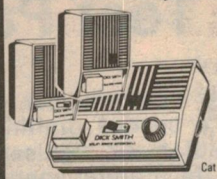

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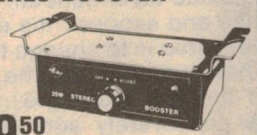

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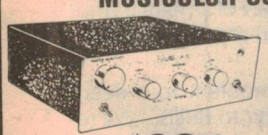

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For all hams or would-be-hams! This kit includes paddle & all components, inc. case (panel is not marked). Variable speed in correct proportion, inbuilt oscillator. Suits most transceivers.

Cat K-3470

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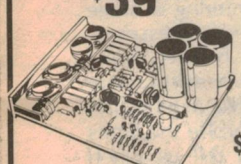
ETI 300W AMPLIFIER



More power for your dollar! Massive 300W; ideal for groups or serious audiophiles. Kit for complete module, as shown.

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Dick's own 240V fully approved mains soldering iron. Supplied with free solder sample, great value for hobbyist & technician alike. 25W rating.

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Building computer oriented projects? You'll need a keyboard sooner or later. This deluxe keyboard features individually switched keys with removable tops (comes in standard 'QWERTY' format) with gold plated contacts. Full 63 set ASCII characters.

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DON'T THROW 'EM OUT: CHECK 'EM FIRST!

Trouble with batteries is you never know if they're any good. You can't measure them with a meter; so you throw them out. Here's the answer: a battery checker that takes virtually all batteries (even Nicads, etc), loads them properly and gives you a yes/no/marginal reading. Every home should have one!

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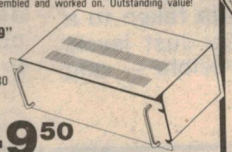
FITS 19" RACK!



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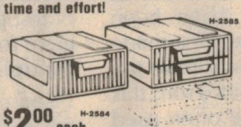
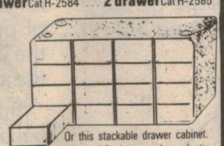


$2.00 each H-2584

Interlocking drawers to build upon as required. Two styles to choose from, deep drawer or 2 x shallow drawer per box. Overall size is 114 x 57 x 130mm (w x h x d). Check them out!

1 drawer Cat H-2584 . . . **2 drawer** Cat H-2585



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12 drawer:	H-2586	$12.50
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Dick Smith and Staff

Need a digital keyboard?

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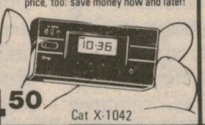

Cat X-1042

BARGAIN 12 VOLT CLOCK MODULE

This has to be the bargain clock of the decade! It's a full fluorescent display with large bright green digits (ideal for daylight use) complete with alarm (buzzer fitted) Runs off 12 volts, with 'inhibit' line for battery saving. Incredibly accurate (quartz crystal timebase); great for building into cars, boats, planes, etc etc.

WAS $19.50

Cat X-1045

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WHAT A SAVING!

AMATEURS:

DON'T BUY A NEW HF TRANSCEIVER UNTIL YOU SEE THE NEW DIGITAL YAESU FT-707!

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- Tiny! just 240 (w) x 93 (h) x 295 (d)
- All solid state
- Single knob tuning & band change
- LED S meter, Power meter
- Variable IF bandwidth control
- Wide receiver dynamic range
- 13.5V DC operated (1.5A R; 20A T)
- Much lower price than most HF rigs with far less features!!!

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Cat D-2869

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How Semiconductor Test Patterns are Made

The successful manufacture of semiconductor test patterns is a delicate and painstaking process. The photographs accompanying this article and the diagram (right) show how it is done in the NBS Centre for Electronics and Electrical Engineering. Although this is only a comparatively small research operation, the principles and techniques employed for making test patterns are similar to those used by most commercial manufacturers for making semiconductor integrated circuits.

The test patterns are built in stages by a technique called "photolithography" which includes aspects of both lithographic and photographic printing. Each structure within the pattern includes several layers, with one layer laid atop the next. Each layer requires a separate transparency or photomask which contains the design for that layer.

The designs for NBS test structures are originally drawn by hand, many times their final size. The photo on page 19 shows Kerry Fischer entering a test structure design into the computer memory. She uses a special drafting board called an automatic digitiser. As the pointer on the drafting board is moved across the drawing, the key points of the design are automatically converted to a set of co-ordinates in the computer and stored on magnetic tapes. The tapes are used to control a pattern generator which makes the photomasks for each layer.

In the meantime, wafers are cut from a blank cylinder of pure silicon crystal using a special circular saw blade that cuts with its inside edge rather than the outer one. The wafers are about the thickness of a fingernail or 0.25mm thick. The wafers shown are 50mm in diameter, sufficient for testing purposes. Commercial wafers may be as large as 75 to 100mm in diameter.

The cut wafers are separated and polished. NBS technician Louie Robinson is shown on page 23 holding a polishing disc with six wafers mounted on it. After polishing, the wafers are taken to a "clean room" — where dust levels are kept as low as possible — and washed.

The wafer is now ready for the photo-lithography process. The accompanying diagram shows how this is done for a comparatively simple device, a metal-oxide-semiconductor field effect transistor, or MOSFET. A thin, insulating layer of silicon dioxide is formed on the surface of the wafer when it is heated to 1000°C in a special controlled-atmosphere furnace. (A*)

The wafer is then covered with a thin layer of a light-sensitive lacquer called "photoresist." The first photomask (B) is positioned over the wafer, and the disc is exposed to ultraviolet light. When the wafer is washed in special solvent, the photoresist washes away from the areas left exposed by the two rectangles in the photomask. A second bath in an etching acid dissolves the silicon dioxide layer beneath the two rectangles and exposes the silicon.

The next step is to change the electrical characteristics of the silicon beneath the two rectangles. This is done by deliberately adding an impurity of "dopant," which in this case is boron. (C)

A traditional method is solid diffu-

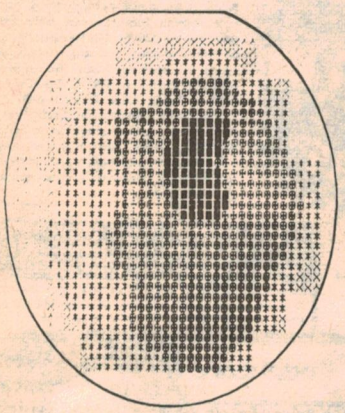
---

points, current, time, and length," he says. "We transform these data into physical parameters like sheet resistance (a measure of dopant concentration), defects in line width or alignment, profiles of dopants, and the like. Time is measured to give an idea as to how long the integrated circuit will hold a given electrical signal."

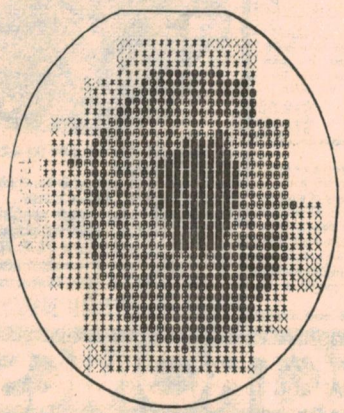
Panics & the PVW's

Test patterns in themselves are nothing new; most manufacturers use test patterns extensively during the initial design and production of new integrated circuits. Once production processes have been refined the number of test patterns made on each wafer is reduced to maximise the production of integrated circuits. From this stage on, the test patterns are often used only when a problem arises in the production process.

"Some people call these things 'panics'," says Buehler, "because they're used only in a crisis situation."



This map shows the resistance of one layer of a process validation wafer covered with NBS-7 test patterns. Light areas depict lower resistance, while darker areas show higher resistance.



A map showing the gain of the same layer of the PVW. The similarity betweeen the two patterns indicates that the gain of the transistors in the wafer can be controlled by changing the resistance of this layer.

The NBS group wants to encourage the use of test patterns and statistical analysis of test pattern data as part of a regular program to keep production processes "under control."

You can reduce the problem to a need for uniformity," according to Bullis. "We're dealing with extremely complicated processes with many, many steps. It used to be that you could figure on taking a batch of production devices, taking a sample of the batch, and testing the sample to get the characteristics of all the devices.

"But now we're seeing increasing complexity. The number of individual elements in a given circuit is increasing, there are more functions per individual chip.

"What we have here is a very high technology field that is entering a stage that pushes the materials and processes involved further than ever before. Make things smaller, make them perform more functions. We have to have a measurement technology that can probe the limits of these processes – and tell us when they've been reached," Bullis concludes.

"Test patterns are going to become more and more important in the future," agrees Gary Carver, a physicist in Bullis' division. Many large semiconductor companies have process engineers who work a lot by intuition, he says. "But when they start producing circuits with Very Large-Scale Integration, they're not going to be able to get away with that."

sion. The silicon wafers are inserted in a quartz rack inter-leaved with wafers of the appropriate dopant.

The rack is placed in a high temperature diffusion furnace, and atoms from the dopant migrate to the exposed surface of the silicon wafer. The photos on page 24 show NBS technician John Krawczyk loading a typical diffusion furnace.

Although diffusion furnaces such as this one are in common use, there are other ways of introducing impurities. One technique, now widely used in industry, involves firing a controlled beam of dopant ions into the crystal.

The rest of the production process basically repeats these steps.

A second photolithography step using another photomask exposes the silicon between the two doped rectangles (D), and another treatment in the furnace forms a layer of silicon dioxide in this area (E). This will produce the "gate" of the transistor which acts as an electrically controlled switch.

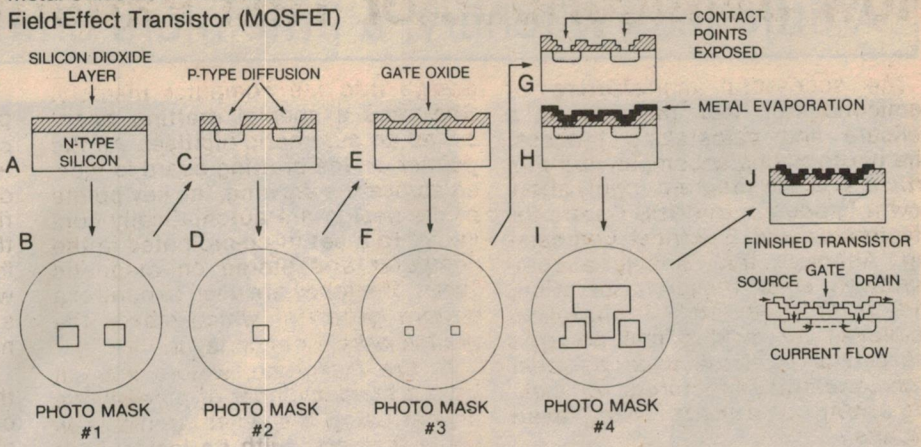
A third photomask opens holes for electrical contacts through the oxide layer to the doped areas (F,G). An evaporation step covers the surface with a layer of aluminium metal (H). Finally, a photomask defines the interconnecting lines of the circuit and the excess metal is etched away leaving the finished pattern (J).

This is the final step for most test patterns constructed at NBS. To finish the process of producing actual circuits, a semiconductor manufacturer would inspect the wafer visually for obvious flaws, test it electrically with probes, and then the wafer would be scribed and broken into individual integrated circuit chips.

Wire leads are connected to each chip, usually by a machine that welds fine wires to contact points with a burst of ultrasonic energy. The chips are then packaged in a protective capsule. On page 24, Y. M. Liu, who manages the NBS semiconductor processing facility, is shown packaging a finished test pattern chip inside a glove box filled with inert nitrogen gas to protect the chip from contaminants such as moisture.

*Letters in brackets refer to sketches in accompanying illustration.

Metal-Oxide Semiconductor Field-Effect Transistor (MOSFET)

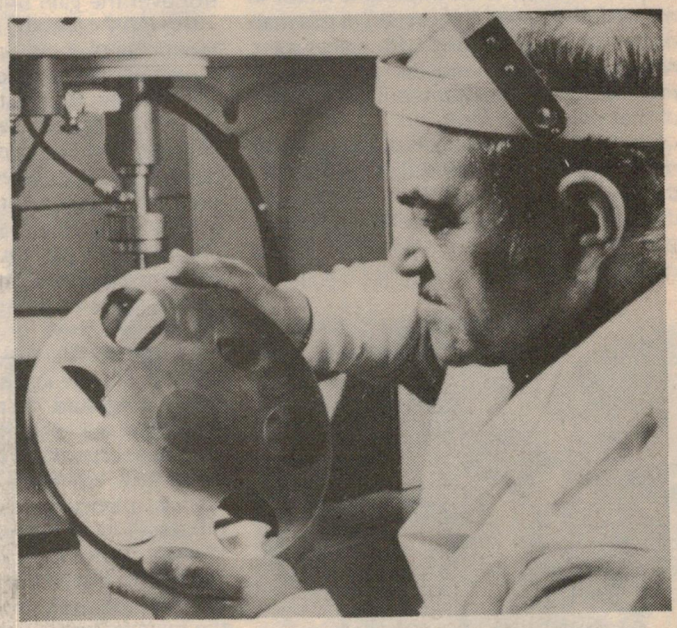


The NBS approach to integrated circuit process control rests on two ideas: the use of test structures that isolate particular factors in the production process (line widths, dopant concentrations), and the use of high speed electronics and statistical analysis to make the best possible use of the data obtained from the test structures.

The second of these two ideas depends on the use of "process validation wafers" or PVW's. A PVW is a complete wafer that holds nothing but test pattern chips. The same test pattern is repeated across the whole wafer in the same way that integrated circuits are made. To see how this works, consider a typical test pattern that might be found on a PVW.

Microelectronic test pattern NBS-7 is an experimental pattern designed for production lines that make TTL (transistor-transistor logic) integrated circuits which are used in many computers and digital instruments. Some of the things tested by NBS-7 are variables in the production process, such as the electrical resistance of each circuit layer or the alignment and resolution of the photomasks. The pattern also includes several NAND gates to provide a link between the characteristics of the test structure and those of the circuit elements, as well as structures to test for "random faults" that can lower the total number of "saleable" circuits.

The PVW is treated in the production process as if it were a production wafer.



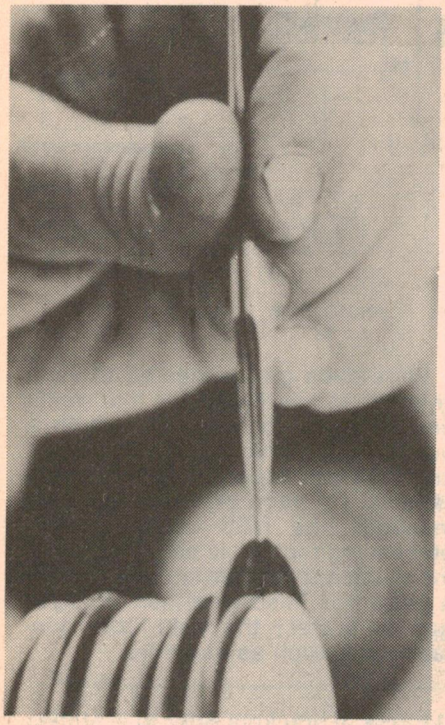
NBS technician Louie Robinson holds a polishing disc with six silicon wafers mounted on it.

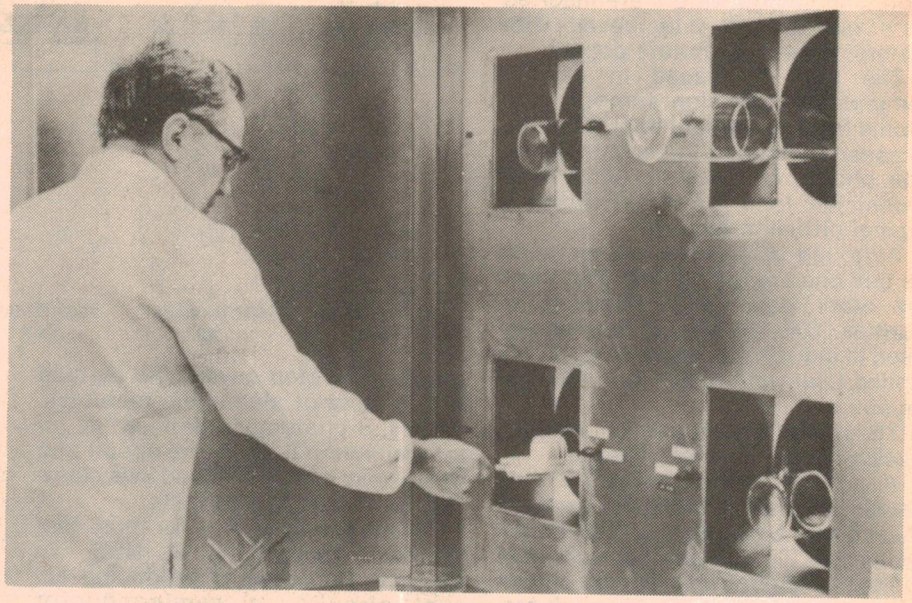
The appropriate photomasks are prepared, and the PVW is made using the same equipment and procedures as in making any other wafer. The advantage of this system is that the data gathered from all the test patterns on the PVW can be used to assemble a detailed "map" of selected factors over the entire wafer, something that can't be done accurately with a handful of test patterns on a production wafer.

The wafer map shown on page 22 was made from a PVW covered with NBS-7 test patterns. The map depicts the electrical resistance of a layer of the wafer which forms part of the PVW transistors. The map shows a pattern of lighter and darker areas which represent lower and higher values of resistance.

A similar map shows the gain of the transistors on that same PVW. (Gain, a

A little less witchery, a little more craft

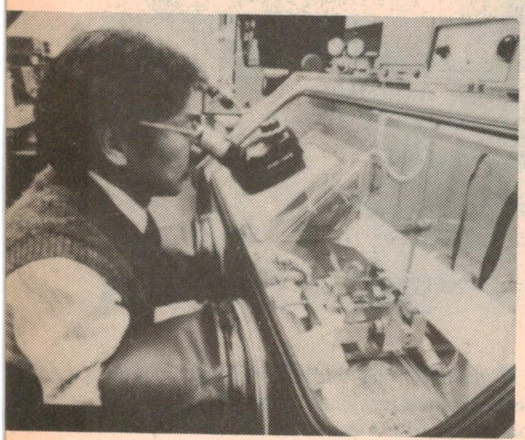




Left: To change the electrical properties of the silicon, wafers are inserted in a quartz rack and inter-leaved with the appropriate dopant. The wafers are then heated in a special high temperature diffusion furnace (above), causing the atoms from the dopant to migrate to the silicon.

measure of the transistors' ability to amplify a signal, is an important factor in the performance of the circuit.) In this map darker areas correspond with higher gain. Notice that the transistor gain follows roughly the same pattern as the resistance of that one particular layer.

For the process engineer, this means that out of a number of factors that could affect the gain of transistors in this type of circuit, the one to watch is the resistance of that layer. By controlling the resistance through variations in dopant densities or other measures, the engineer can also have control over the gain of the transistors.



Y. M. Lui, manager of the NBS semiconductor processing facility, packages a finished test pattern chip inside a glove box filled with inert nitrogen. The function of the package is to protect the chip from moisture and other contaminants.

The PVW concept, according to the NBS researchers, offers several advantages over more traditional ways to use test structures. In the first place, it provides much more comprehensive data. It does so cheaply, and without disrupting the production process. The PVW "maps" can be used to diagnose production problems quickly without wasting money producing unusable circuits. If it becomes necessary to change the test pattern, a new PVW can be designed without changing the photomasks used for production wafers.

But the PVW's greatest potential, says Buehler, may lie in assuring quality control when integrated circuits are bought and sold. How is a customer interested in buying several thousand integrated circuits to know how reliable a manufacturer's product is, particularly when several of the processes involved may be trade secrets? In most cases a PVW can be designed and certified to test all the factors of interest to the customer with minimum knowledge of the manufacturer's operation.

Documented Structures

Regardless of the type of testing used by integrated circuit manufacturers, NBS can often provide information or services to help make their quality control procedures easier and more efficient.

A large part of the NBS effort in this area is devoted to providing carefully documented information on specific test structures to interested users. This information is distributed through reports and conferences and can be adapted by manufacturers to suit their individual needs.

The manufacturers who use this information include a number of organisations other than commercial semiconductor suppliers. Companies that manufacture automobiles, aircraft, computers, cameras and electronic instruments, as well as universities and government laboratories, are all interested in the use of test structures for process control. NBS has already supplied its test structures to over 60 such organisations.

In addition, NBS provides the designs for complete test patterns. Four of these are currently available to the general public. Test patterns NBS-2, NBS-3, and NBS-4 provide tests of transistor gain, electrical resistivity of various layers, dopant density and bulk resistivity. Test pattern NBS-15 provides tests for alignment between masking levels. The first three patterns can be obtained in the form of photomask sets, while the fourth is made available in the form of test structure co-ordinates recorded on magnetic tape.

For information on these and other facets of NBS work on semiconductor measurement technology, contact the Electron Devices Division, National Bureau of Standards, Washington, DC 20234, 301/921-3786.

Reprinted from "Dimensions," journal of the National Bureau of Standards, Washington DC.

Facts from Fluke on low-cost DMM's

Investigator at work: The shortcut to continuity checking.

At times like this, every minute matters. You could spend hours searching for a single short or open.

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FORUM

Conducted by Neville Williams

WHY ARE THE POWER MAINS EARTHED?

If you fiddle with the kitchen light while standing barefooted on the stainless steel sink, you'd be asking for trouble. Would you be less at risk while doing this, or some other foolish thing, if one side of the power mains was not earthed, as it is at present?

Whether in the kitchen or elsewhere, one would have to be crazy to take deliberate risks with 240 volt mains wiring but the fact is that, despite ordinary care, people do get caught at times — perhaps with tragic results. Are we adding to that risk by having one side of the mains tied down to earth? That is the burden of the following letter:

Dear Mr Williams,

Your recent "Forum" on the subject of current flow stimulated a question that I have been harbouring for years. I have raised it again with several identities in the electronics industry — without getting positive answers. They all agreed that it would be a good one for "Forum".

The questions is this:

Why do we have an earth system associated with our electric mains distribution system?

One would think that the answer is obvious — for safety purposes, of course. However, is this really the case?

Surely if our entire mains system was "floating", it would be far safer to handle a faulty electrical appliance than if (in the case of the present system) the neutral return is effectively at the same potential as Earth?

The present system by default virtually ensures that you are in live contact with one conductor at all times.

By insulating (or isolating) the neutral conductor from earth you would have to get inside the faulty appliance and between the conductors in order to receive an electric shock. This, of course, is a far more unlikely scenario than the existing situation.

I believe that a long time ago electric current was once distributed by the active conductor only. The circuit was completed through "ground". I can see that if any such distribution systems still exist in Australia, a case for "grounding" all appliances could be argued. Perhaps the original reason was the high cost of copper? Surely in this day and age though, such distribution systems no longer exist.

Perhaps I am missing the obvious. Your comments would be appreciated.

Yours faithfully,

G. J. (Lane Cove, NSW).

Thanks for the suggestion G.J. Life wouldn't be quite the same if ever we ran out of things to argue about! As for grounding of the power mains, I recall some earlier lively debate on the subject but I cannot pinpoint exactly where and when. So let's look at it again.

The letter brought to mind the dilemma of a friend who I found fiddling with the underwater light installed in his swimming pool. He had the fitting in pieces, trying to overcome its tendency to act as a thermal pump: When switched on, heated air under pressure would be expelled through the sealing gasket; when switched off, the air would contract and suck in an equivalent volume of water.

In a low voltage system, this may not have mattered a great deal — but this particular light operated at 240V, straight from the power mains. When he inquired around, one of the suggestions put to him was that he should install a 1:1 transformer to isolate the lamp circuit from ground.

Had it been my problem, I would have been going for low voltage as well! But that is by the way.

As G.J. suggests, it may well be that reticulation systems existed sometime, somewhere, in which the earth provided one of the active conducting paths. However, without getting involved in a lengthy research effort, I could find no reference to any such installation in the books which were to hand. On the contrary, even the very early systems illustrated used multiple metal conductors merely referenced to earth in one way or another — much as we do now.

The earth does, of course, play a part — even if involuntary — in traction systems involving supply via an overhead wire or third rail, and a return circuit via the normal running rails. The earth gets involved because, along with buried water pipes and other metallic structures, it may provide an alternative return circuit of comparable or even lower resistance than the rails.

Again, in some modern high power transmission systems using high voltage DC, conduction via earth (or sea water) plays a part. Power is transmitted by means of cables operating typically at plus and minus 300kV with respect to earth. Systems mentioned to us include links between Sweden and the island of Gotland, Italy-Sicily, France-Britain and between the two islands of New Zealand. But, again, this is well removed from what G.J. is talking about in his letter.

In the realm of ordinary street reticulation — both HT and 240/415VAC — an earthing provision was simply taken for granted in virtually all the books we turned up. Whole chapters are devoted to the "how" of earthing but not a word about the "why".

It was much the same when we began to ask questions of friends in the electrical/electronic area. They accepted it as normal and appropriate that the mains should be referenced to earth; to find reasons why it should be so, they had to start thinking it through.

Curiously, the first printed reference to "why" that we found was in that one-time bible of the electrical/wireless fraternity, the Admiralty Handbook — an early edition, issued during the 1920s.

In a chapter dealing with transformers, the authors stress the desirability of referencing a high voltage winding to earth, preferably via the centre-tap. They quote the example of a 14kV winding; with an earthed centre-tap, the insulation to do with

the respective ends of the winding and everything connected thereto could be designed to cope with 7kV. On the other hand, if there was no deliberate earth return, the possibility would exist of a leakage path grounding one side of the system; this would stress the insulation on the other side to a possible 14kV, thereby requiring a greater safety margin.

As you might imagine, it didn't take long for people, with whom we discussed the matter, to work their way round to this point, up-dating it to cover modern transmission lines and high-voltage 3-phase street distribution.

But they also made the point that it applied equally well to normal household supply wiring. With the system earthed as at present, the voltage on any one phase with respect to earth will not vary significantly from 240VAC. Insulation requirements can be determined on that basis, and the same figure can be taken as a measure of user hazard.

If the system were allowed to float and one phase became accidentally grounded somewhere, the neutral would jump to 240V with respect to earth and the other phases to about 415V — right throughout the system. Very nasty!

That cannot happen if the neutral is solidly grounded. A short circuit to earth on any phase blows the local fuse or trips the local circuit breaker, thereby isolating the fault. The remainder of the system is substantially unaffected.

In short — oops, I mean in this connection — earth plays a vital role!

But G.J.'s idea of a floating system is an illusion anyway and, along with it, the assumption that such a system could have zero potential with respect to earth.

For a start, any practical system will have a huge distributed capacitance to earth. Unless I am much mistaken, if the capacitance between each phase active and ground is about the same, the end result will be as if the neutral was grounded through the total system capacitance. In that case, the hazard of getting between any one of the actives and earth would be virtually the same as getting between the active and neutral. For all practical purposes, there would be no additional safety.

SAFETY MAY SUFFER

On the contrary, I can suggest at least two reasons why safety would be diminished:

(a) Lack of symmetry may cause some phases to rise above earth by more than 240V;

(b) Lack of solid earthing may inhibit the operation of protective fuses or circuit breakers.

But the problem wouldn't end there, according to one of my informants. As he thought about the proposition, he became quite worked up about the effect of capacitive and inductive coupling between phases, between high voltage and low voltage distributors and across pole transformers. He was inclined to think that, without the stabilising effect of a very deliberate earth system, all manner of anomalous potentials could appear on the lines.

Concern was also expressed about the possible effect of static buildup on a non-earthed system, in some circumstances, and of lightning strikes. Apart from their contribution to human hazard, spurious voltages or surges on the power lines could cause problems with equipment. Logically, it would seem, the more solidly equipment is tied down to earth, the better for everyone and everything concerned.

The last sentence brings me to the

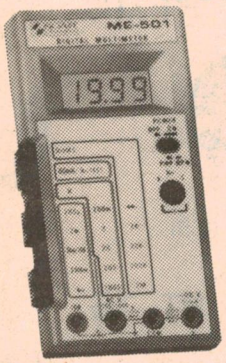
Safety first for pool lighting

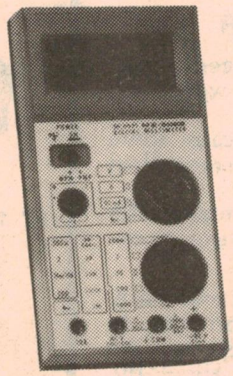
By sheer coincidence, this pool underwater lighting transformer turned up from Ferguson for possible inclusion in our "Products" pages. Identified as type TSB-201, it has a secondary rated at 32V, 4.7A and is intended for use with a 32V 150W globe, as mounted in the usual sealed underwater housing. Approved by State supply authorities, the transformer itself must be installed in a position sheltered from the weather. Overall dimensions are 105mm × 90mm × 180mm and weight 3.75kg. At $34 plus 15% sales tax, it is available through Ferguson outlets or direct from Ferguson Transformers Pty Ltd at 331 High St, Chatswood, NSW 2067. For situations where the step-down transformer must be mounted in a position exposed to the weather,

Ferguson suggest the somewhat more expensive, sealed unit, type TF32/150. Both units belong to a range of special purpose step-down transformers manufactured by Ferguson.

GET SOAR
AND GET THE BEST!
A COMPLETE RANGE OF DIGITAL METERS

Personal D.M.M.





Features

1. Large Display allows correct measurement and readout.
2. High Internal Resistance reduces errors in measurement.
3. The adoption of LSI design reduces troubles and erhances durability and quality.
4. Can measure hFE of Transistor.
5. Can check Diode.
6. Battery lif : 300 hours (typical).
7. Skinny and portable type.

Hand Held D.M.M.

MODEL
ME-523

Features

- FE Type liquid crystal display, 3 1/2 digits.
- The use of C-MOS LSI and LCD reduces power consumption to 15mW and batteries of Zinc-carbon 9V transistor battery work continuously for 200 hours, which a proof of the economy displayed by this equipment. Furthermore, accuracy and reliability are enhanced.
- Liquid crystal display is provided with unit indication of measured values. The equipment is provided with functions such as measurement of (+) and (−) DC currents, input overrange indication, battery discharge indication, etc.
- Highly stable special circuit: In-circuit with the low power high power ohm circuit favorable for checking the circuit resistance and transistors. The double protection circuit design eliminates completely troubles.
  - Excessive input warning: Only (1) or (−1) is displayed at the top of the digit position.
  - Battery voltage warning: The "B" mark lights on the display face, indicating that the batteries are exhausted.

MODEL
ME-521 DX

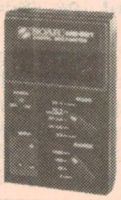
Features

- LED display, 3 1/2 digit positions
- High accuracy + low price
- The LED display face is protected with an acrylic smoked plate, which enables easy readout in the dark.
- Highly stable special circuit: In-circuit with the low power high power ohm circuit is adopted which is favorable for checking the circuit resistance and transistors. The double protection circuit completely eliminates troubles.
- Compact design with an emphasis on easy operation.
  - Excessive input warning: only (1) or (−1) is displayed at the top digit position. The other digit positions do not light.
  - Battery voltage warning: the battery voltage is displayed by connecting test leads to the check terminals.

MODEL
ME-522

Features

- FE Type liquid crystal display, 3 1/2 digits.
- The use of C-MOS LSI and LCD reduces power consumption to 15mW and batteries can work continuously for 200 hours. Furthermore, accuracy and reliability are enhanced.
- The smoke green liquid crystal display surface mitigates weariness of eyes and facilitates readout.
- Highly stable special circuit: In-circuit with the low power high power ohm circuit favorable for checking the circuit resistance and transistors. The double protection circuit design eliminates completely troubles.
  - Excessive warning: Only (1) or (−1) are displayed at the top of digit position.
  - Battery voltage warning: The "BATT" mark lights on the display face, indicating that the batteries are exhausted.

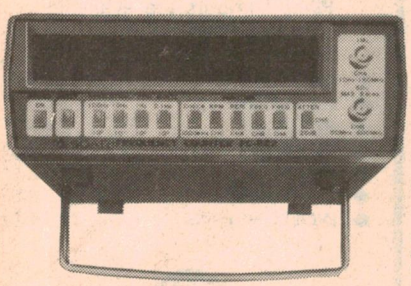


MODEL
ME-521

Features

- LED display, 3-digit positions.
- High accuracy + low price.
- The LED display face is protected with an acrylic smoked plate, which enables easy readout in the dark.
- Highly stable circuit of rational configuration: the double protective design with a protective circuit and a fuse protective circuit completely reduces troubles.
- Compact design with an emphasis on easy operation.
  - Excessive input warning: all the digit positions flicker.
  - Battery voltage warning: the battery voltage is displayed by connecting test leads to the check terminals.

Frequency Counter
F.C. Series

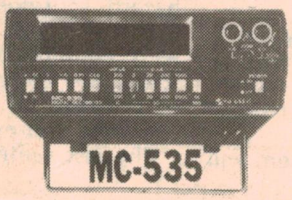


GENERAL

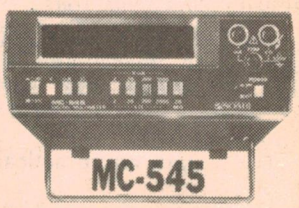
Multifunction	FC SERIES 150MHz(FC 881) 600MHz(FC 882) 1,000MHz(FC883) indicate minimum frequency. But available to mesure more.
Timebase , Stability	0.5PPM(0℃ - 40℃)
External	Time base input frequency required 5MHz sensitivity is 2VPP 10VPP
Sensitivity	20mV rms up to 100MHz decreasing to 35mV rms at 150MHz (FC 881) 1MΩ 30pF max
ATT	20dB $^1/_1$ $^1/_{10}$
Display	8-digit LED display 7segment Over flow indicator Gate time indicator
Osillator Check	Reference osillator 1MHz
Operating	Temperature 0℃ to +40℃
Storage	Temperature −20℃ to +70℃
Power	"C" Size batteries or AC adapter
Dimensions	180(W) × 64(H) × 200(D) mm
Weight	1.2kg

The SOAR FC-841 New Low Cost Frequency Counter
- Full 4 digitdisplay with range switch allows digit accuracy Input Level Indicator
- 10Hz to 50 MHz typical
- Gate time from 100 ms to 1 seconds
- 60mV 20V Input sensitivity
- Operates on "AA" size batteries AC with Optional charger adapter or 12VDC with optional power cord adapter
- Dimensions 100(W) × 32(H) × 120(D)mm Weight 850g

Bench Top D.M.M.



GENERAL
Display 3.5digit LED
Zero & polarity Automatic
Operating Temperature 0 to 40℃
Power "C" size 1.5V×4 or AC Adapter
Size 180(W)×64(H)×200(D)mm
Weight 1.2kg



GENERAL
Display 4.5digit LED
Zero & polarity Auto matic
Operating Temperature 0 to 40℃
Date out put BCD(8-4-2-1)
coad parallel out option
Size 180(W)×64(H)×200(D)mm
Weight 1.2kg

GENERAL
Range DCV, AC V & OHM Auto and MANUAL
Display 3.5digit LED
Zero & polarity Auto
Operating Temperature 0 to 40°C
Power "C" Size 1.5V × 4 or AC Adapter
Size 180(W)×64(H)×200(D)mm
Weight 1.2kg

GENERAL
Display 4.5digit LED
Range DC V, AC V & OHM Auto and MANUAL
Zero & polarity Auto
Operating Temperature 0 to 40°C
Size 180(W)×64(H)×200(D)mm
Weight 1.2kg

AMPEC ELECTRONICS P/L
1 Wellington St, Rozelle 2039. Tel. (02) 818 1166

observation that earthing procedures are becoming more, rather than less rigid.

One man with whom I spoke — an electronics enthusiast with an electrician's "ticket" — told me how he used to live in one of Sydney's northern suburbs where the neutral was earthed only at the distant sub-station. At his end of the line, this kind of earthing was not nearly enough to hold the system down and a fault condition or lightning strike could cause the neutral to surge by hundreds of volts. At the time, the most vulnerable items were stove elements which would arc over internally, even when the stove was not in use.

It is because of situations like this that the neutral is now commonly earthed adjacent to the switchboard of each consumer's premises — the so-called "MEN" (multiple earth neutral) system.

(In these days of so-called sex equality, this will presumably have to give place to the "PERSON" system — Place Earth Return Straps On Neutral!)

But there it is G.J. Whatever other reasons might exist for earthing the neutral of household mains, the following should suffice:

1. It stabilises each active phase around the nominal 240V with respect to earth.
2. It helps protect the system, consumers and appliances from such accidents as lightning strikes, shorts to HT cables, collapsing wires and poles, etc.
3. It makes the operation of fuses and circuit breakers more positive, thereby localising and isolating fault conditions.

Removal of the earth return would sacrifice all these advantages without achieving G.J.'s objective; the actives would still have a potential with respect to earth, no less lethal than at present.

Curses: another brilliant idea down the drain!

One other thing: In talking to people about grounding systems, I unearthed all manner of funny-peculiar situations:

- Wireless sets earthed to an indoor pot-plant.
- Water mains which burst when DC from an adjacent tramway system "plated" the metal on to other surfaces.
- Burglar alarms that would go off in buildings adjacent to rail stations each time a train started.
- Wrangles when a TV tower was erected close to a sub-station; authorities feared that earth currents from lightning strikes would trip their relays.
- Off-shore "earth" systems needed to disperse out-of-balance current in the previously mentioned high voltage DC systems; An excessive concentration of current would disable fish.
- The problems posed by early TV sets using transformerless half-wave power supplies; the DC component created in the system was accused of everything from polarising pole transformers to eating away lead-covered phone cables. In fact, I couldn't help but feel that there must be plenty of material available for an article on "Down to Earth Humour"!

A tale of two sitters!

For want of a better name we called him "John Johnson." He was a male kookaburra and was very young when he appeared out of the bush and adopted our high voltage sub-station as his personal terrain. He would perch on the high voltage cables, on the cross arms or transformers and keep a watchful eye on our doings below.

We used to leave our lunch scraps for him, bring him chopped-up raw meat and talk to him. He was one of us; we treated him as a human being, even though he couldn't talk back. We would tell our kids about John Johnson when we went home at night. He was a character in himself, an individual.

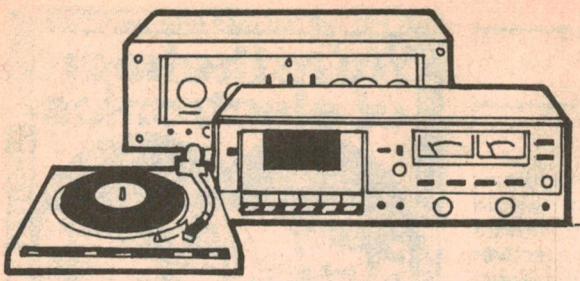
We'd look for him each morning when the truck pulled up outside the locked gate. If he didn't appear straight away, we'd be on the look-out until he did arrive.

With winter ending we began to wonder whether he would find a mate. We'd ask him: "You gonna find yourself a wife? How about that, John Johnson? You gonna take on responsibilities, old feller? Yeah, find yourself a nice little chick, John. One that won't hen peck you."

Then, one beautiful spring morning, she arrived. John was sitting on one of the overhead 11kV bus bars near the centre of the yard, chuckling inside himself. Sabrina landed on the opposite polarity bus bar and some amongst us breathed a silent prayer that they would not reach across and touch each other. "She's a little beauty!" Joe said, watching the antics of the two birds, fluffing their wings, lifting beaks to sky, saying things low in their throats.

Then it happened, they brushed their beaks together. There was a sharp "Splatt!" Both birds fell to earth in a flurry of feathers. An hour later Sabrina had recovered enough to wing slowly away into the bush while John, perplexed, brooded on a stump. As she left, it was easy to imagine her last words. "Phew, that guy's got too much umph for me!"

J.S. (Rivett, ACT)



Hi Fi Topics

CLASS-A HIFI AMPLIFIERS: HERE WE GO AGAIN!

In our February '78 issue, following a visit to Osaka in Japan, we puzzled and postulated about Technics then new "Class A+" amplifier. More recently, at Terrigal on the NSW central coast, we came face to face with its progeny — the Technics "New class A" series. How valid is the term? More importanty, how good are the amplifiers?

by NEVILLE WILLIAMS

As in Osaka, the unveiling of this year's version of class-A was the big moment of the conference, with blackboard and easel, carefully drawn circuits and graphs, and explanatory diagrams complete with cartoon figures. Unfortunately, in the allotted time, the basic principles of "New class A" did not come through as clearly as the claims about its ultimate performance.

Faced with Technics expertise and evaluation methods (eg the 3DA concept, March '80, p26) we were not about to deny the measured results, but we did share reservations about the "how it works" bit.

Because of other activities, it was not possible to pursue the reservations to any conclusion and, as far as this writer was concerned, the matter rested there until I could get back to the office and work things out with our Technical Editor, Leo Simpson.

Our conclusion: the link to traditional class-A operation is rather tenuous. It would have been more accurate – but less appealing – to describe the system as "New class AB". Refined and with a novel twist . . . yes; but still essentially class-AB.

Why do we say that?

As we have pointed out on previous occasions, the terms class-B, class-AB, class-A, etc, have their roots in valve technology, as also do their "poor-average-good" connotations. In those days class-B was strictly for public address applications; class-AB combined economy with acceptable quality; class-A was the mode beloved by generations of hifi buffs. The tradition remains, despite 20 years of technological change.

The SU-V4 "New class A" amplifier, as mentioned in the text, delivers between 55W and 75W per channel, depending on load and rating conditions and retails for around $400. It is very similar in appearance to the SU-V2 model pictured last month, rated at 45W to 55W per channel and priced at about $300.

In a valve type class-A push-pull output stage, both valves were biased to the centre point of their dynamic load line. Neither was driven into saturation or beyond cut-off and each delivered power to the output load over the entire signal cycle. Even order harmonic distortion tended to cancel automatically and odd order harmonics were minimised by keeping the drive well below overload and, later, by the use of negative feedback.

By the standards of the day, a well balanced class-A amplifier was the ultimate and it remains so, as hifi "doctrine."

Fundamental to traditional class-A operation was (and is) the fact that the output stage drew a standing current half that of the current on signal peaks. But, even forgetting the heaters, conversion efficiency was well below 50% and a pair of output valves in class-A would typically dissipate, as heat, up to three times as many watts as their rated output power.

This intrinsic characteristic of class-A proved a major stumbling block in the design of equivalent high-power solid state amplifiers. More or less of necessity, most designers opted for nominal class-B operation of the output stage, relying on generous negative feedback to clean up the waveform.

The output transistors were biased just a little above cut-off so that they would draw minimal current during no-signal or low-signal conditions. It made things a lot easier in terms of heat rise, heat sinking, thermal drift, and power supply dimensions.

But class-B (or AB) has one major drawback: each transistor works over little more than half of the total signal cycle and "switching" or "crossover" distortion is liable to occur where each transistor cuts off and its opposite number takes up the load.

How to deal with crossover distortion has long been a hassle for designers of transistor amplifiers – but it is one that is now pretty well under control. If it were not, Technics themselves would not be able to claim distortion figures of well under 0.05% for their "budget" model 2 × 45W class-B amplifier SU-C03.

However, despite figures like this, the lure of class-A remains – a somewhat il-

lusory dream for hifi buffs, a tempting morsel for marketing managers and a continuing challenge for system designers.

In fact, a small number of traditional class-A solid-state amplifiers have made their appearance on the market but they have commonly been massive units with a huge power supply, huge heat sinks and cooling fans for good measure. Highlighting the problem, Technics state, in their introduction to "New Class A", that a true 120W+120W class-A amplifier would require a power supply rated at 1.4kW!

Operating such an amplifier in the listening room on a warm summer evening would be like having a radiator switched on.

In the face of figures like that, it is not surprising that a succession of designers have sought to produce amplifiers which combine the characteristics of class-A with the power supply economy of class-B. In fact, the two aims are really quite incompatible, unless we are prepared to re-write tradition!

One approach has been in the use of so-called "sliding bias", with the output stage bias being varied according to the instantaneous signal level. In practice, the system can introduce as many problems as it solves. If the bias "slides" at the signal frequency rate, intermodulation distortion can be produced; if the rate of change is slowed down, the system can be caught out by high amplitude transients.

British QUAD came up with a more elegant scheme with their so-called "current dumping" amplifier, involving virtually two output stages in parallel. At very low signal levels, power is transferred to the load by a small and economical class-A stage. As the signal level increases, a high-power class-B stage is activated, fed from its own supply. The system is claimed to provide high power output without switching distortion.

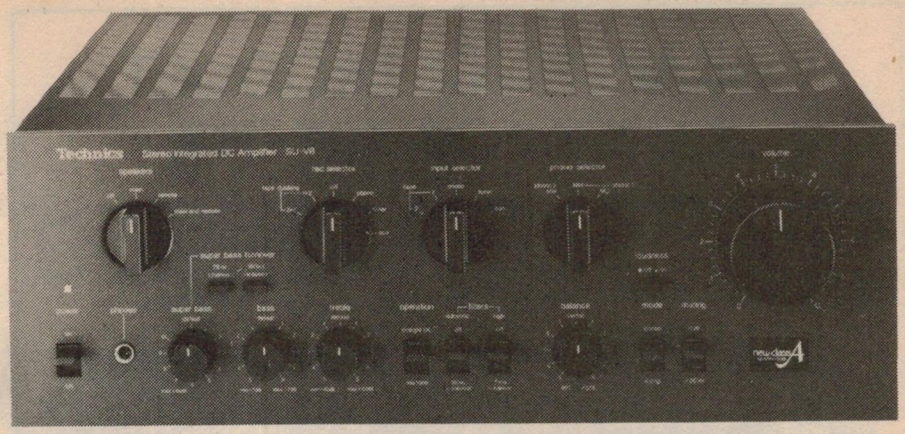
The Technics "Class A+" amplifier, reported in the February '78 issue, achieves much the same kind of end result but in a completely different way. But, whereas QUAD invented their own name for the hybrid mode, Technics chose to invoke and adapt the magic phrase "class-A".

It had been the company's intention to produce a whole series of "Class A+" amplifiers but the approach proved to be too costly. Not to be outdone, however, they dreamed up another circuit configuration on which they could conceivably hang a similar tag. So we have "New class A"!

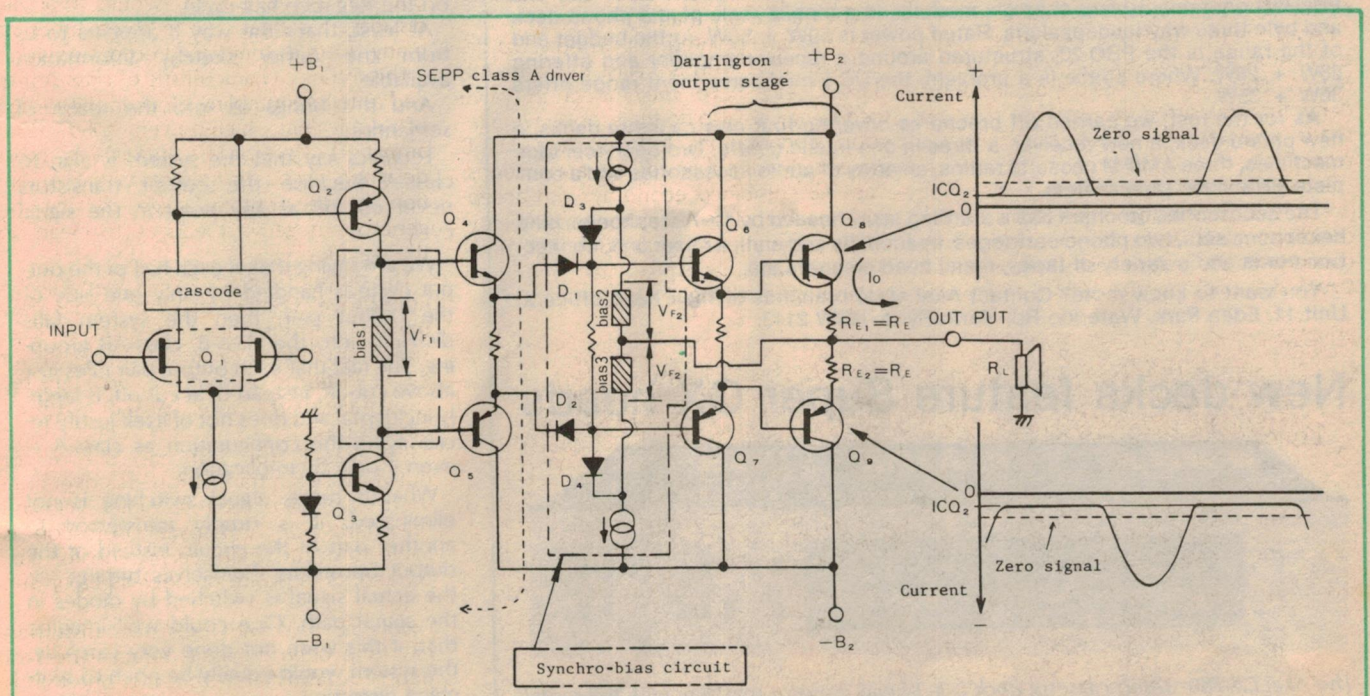
In explaining the title, the lecturers at Terrigal were keen to point out that the output transistors were never driven into cut-off, and that both transistors continued to draw current during the whole of the signal cycle. This was one of the hall-marks of class-A; hence the use of the term.

But, but, but . . .

If, to conserve current drain, the output transistors were biased close to cut-off, it



For those who want power to spare, this "New class A" SU-V8 retails for around $700 and delivers 105W+105W into 8 ohms or 140W+140W into 4 ohms, both channels driven; this, continuous, for all frequencies between 20Hz and 20kHz. THD at full power into 8 ohms, 20Hz to 20KHz, is 0.007%. Maximum available power is 160W+160W.



Reproduced from a Technics brochure, this shows the basic circuit configuration of the "New class A" system – the only information available to us at the time of writing. Diodes D1 and D2 decouple the drive from the bases of Q6 and Q7 on alternate half-cycles, so that they are not carried into cut-off. The two curves (right) show how the respective output transistors idle just above cut-off, when not delivering power to the load. The apparent merit of the system is that signal switching can be more precisely controlled, while also avoiding charge storage problems in the output stage.

AKAI'S HUGE PRODUCT RANGE FOR THE '80s

At the Amory Restaurant in Ashfield, Sydney, Akai Audio/Video Pty Ltd recently unveiled their impressive product range for the 1980s. There is only one thing wrong with it: in no way can the range be summarised in two columns of magazine space!

For the hifi buff who is untroubled by cost, Akai suggest their PS series tuner/control unit/power amp combination.

The PS-200T tuner (pictured) contains a whole array of state-of-the-art circuitry, including a microcomputer to bring together the various functions. It provides for AM and FM stereo coverage, with manually supervised scan or step tuning. The information about a preferred station can be stored in a battery-maintained memory bank and allocated to any of 15 press buttons. A digital display shows the frequency of the incoming signal.

Companion unit for the tuner is the matching slimline control unit PS-200C, which offers a full range of facilities, plus very tight performance specifications, including THD figures of .005% or less.

For the power amplifier, there are two options, the first being the PS-120M with a "mere" 120W + 120W output into 8 ohms at a THD of .008%. For those who may want a bigger noise, the PS-200M will produce 200W + 200W for the same load and distortion figures. Add the appropriate mobile rack and you have quite a system!

Once in the realm of systems, there are at least seven to choose from. The PRO-601 contains no less than six modules in a mobile rack, plus a phono deck and twin three-way loudspeakers. Rated power is 50W + 50W. At the budget end of the range is the PRO-20, structured around a receiver/amplifier and offering 28W + 28W. Where space is a problem, the UC-5 mini-component range offers 35W + 35W.

As for the rest, we carried off brochures covering four new cassette decks, a new phono deck, a new receiver, a three-in-one music centre, two open-reel tape machines, three AM/FM cassette radios, an array of audio accessories and a complete VHS video tape system.

The accessories brochure has a startling array headed by 10 microphones, nine headphone sets, two phono cartridges, headshells and styli, a mixer unit, connection cords and a variety of tapes, reels, head cleaners etc.

You want to know more? Contact Akai state branches or their head office at Unit 11, Eden Park, Waterloo Rd, North Ryde, NSW 2113.

New decks feature Super GX heads

The Akai GX-F80 stereo cassette deck is a 3-head 2-motor machine with full metal tape capability. All heads are of the super GX type. The three heads, plus double Dolby circuitry allows accurate off-tape monitoring while recording is taking place. Controls are of the "feather-touch" logic type and metering is by fluorescent bar display. Wow and flutter is quoted as less than .035% WRMS, response to 21kHz (+,−3dB, −20VU, CRO2), S/N ratio 61dB (depending on tape).

seemed obvious that they could not cycle each symmetrically through the signal waveform in the manner of traditional class-A. Furthermore, a signal large enough to drive them to near saturation surely had also to drive them well below cut-off.

There had to be a missing link somewhere, buried in the jargon.

Back at the office, Leo Simpson and I sought it independantly and then compared notes.

On the blackboard, Technics' illustrative circuit showed a pair of composite output stages, each biased slightly above cut-off, as with any other class-AB output system. With no signal input, both stages are drawing the usual small standing current and making minimal demands on the power supply.

With a very small signal input, both transistors respond and feed power to the load — normal class-AB practice.

The abnormal thing is that, in the Technics amplifier, there is a diode in series with the signal path to each of the composite output stages, and this has a dramatic result.

On the positive half of the signal cycle, for example, the upper diode conducts and carries the base of the upper composite stage through the positive excursion. However, as the signal progresses into the negative half-cycle, the diode opens and breaks the signal path. In consequence, the upper transistor is not driven into cut off; it simply idles at the standing bias level until the next positive-going excursion.

The other half of the push-pull output stage operates in complementary fashion on the negative half-cycle.

At least, that's the way it appears to us from the rather sketchy information available.

And this brings us into the realm of semantics.

Technics say that the system is akin to class-A because the output transistors never cut off at any point in the signal cycle.

We are saying that, if each half of the output cycle is handled by only one side of the output pair, then the system falls distinctly into the class-B, class-AB grouping. The fact that each output pair idles just above cut-off, instead of at cut-off, is largely incidental and does not of itself justify reclassifying the configuration as class-A — even if only by implication.

What is more, signal switching is not eliminated; it is simply transferred to another part of the circuit. Instead of the output transistors themselves turning off, the actual signal is switched by diodes in the signal path. One could well imagine that, if this were not done very carefully, the system would equally be open to switching distortion.

In fact, it is evident from the literature that Technics engineers have been fully alert to this possibility and the multiple biasing system (they refer to it as "synchro-bias") ensures that the switching occurs in exactly the manner intended. They also

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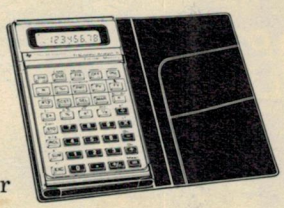

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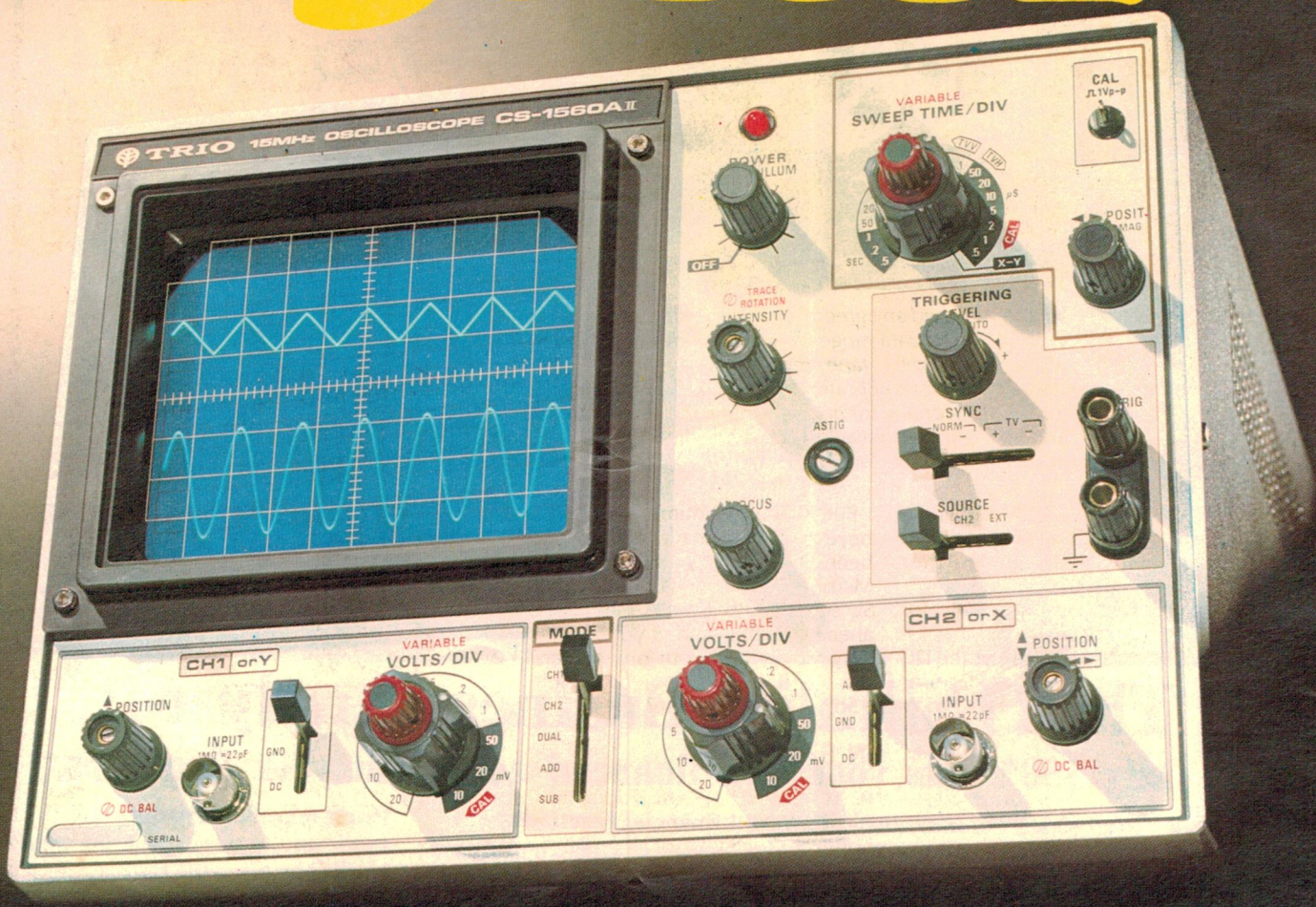

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Electrodata Associates Pty Ltd have signed an agreement giving Bell& Howell Australia Pty Ltd world marketing rights to the Electrodata range of Australian designed and manufactured instrumentations and voice logging tape recorders. Launched in 1970, the recorders have been widely accepted for applications like air traffic control monitoring, telephone betting recording, sonar recording for naval activities and medical research. Mr Robert Stirling, general manager of B&H Australia (left) appraises the 6500 series recorder, while its Australian designer, Dr Stan Baker, looks on.

use high-speed diodes, SLPT's (super linear power transistors) and a carefully designed driver system by way of further refinement.

And the published results speak for themselves:

The SU-V4, in about the middle of the DC "New class A" series is a likely choice for the average hifi buff. It offers 55W+55W into 8 ohms at a distortion level of 0.02% at full power over the range 20Hz to 20kHz. IM distortion is 0.03% and power bandwidth (−3dB, 0.02% THD) is 5Hz to 30kHz. Measured power into 4 ohms at 5kHz runs to 75W+75W, both channels driven.

Considered together with an array of other commendable specifications, it adds up to an amplifier which is impressive by any standards. And the same remarks apply to others in the series.

I guess that, having been brought up on a steady diet of 45 and 2A3 valves, I have more of a problem with sematics than members of the solid-state generation!

But, in the meantime, you the potential buyer may also have a problem. I have been warned by Technics Marketing Manager Peter Lee that the demand for the SU series ("New class A") amplifiers is way ahead of supply and, if you want one, you may have to put your order in and wait a bit.

So, what's in a name?

IN BRIEF . . .

R. H. CUNNINGHAM PTY LTD have a "flight case" or "road case" package which houses a selection of capsules from the Sennheiser electret condenser microphone range. One K3U powering module is included, together with mic heads all the way from a lapel mic to the "shot-gun" ME88. The kit comes complete with cables and windshields but there is room in the case for additional items, batteries, etc. The road case is itself very rugged and can be checked into airlines along

From a photograph, Sanyo's M9998K might be mistaken for an ordinary cassette/radio portable. In fact, it is a large unit measuring 664mm × 245mm × 145mm (w,h,d) and weighing 9kg. But it provides AM, FM-stereo and SW coverage and delivers 6W per channel to two 2-way speaker systems. The tape system incororates Dolby NR and connections are available for phono.

Movies on Videocassettes

Magnetic Video (South Pacific), a division of Twentieth Century Fox Film Corporation (Australia) Pty Ltd, officially launched its pre-recorded videocassette distribution scheme on April 14. Forty-five titles are available initially, many of them Academy Award winners such as Butch Cassidy and the Sundance Kid, and M.A.S.H. Two formats of pre-recorded videocassettes, VHS and Beta, are being produced by AAV-Australia Pty Ltd in Melbourne, and it is planned to release additional titles on a regular basis, including educational features such as tennis lessons by Billy Jean King, and of course, more movies from Twentieth Century Fox. Magnetic Video cassette prices start at $37.95. Further details, including an illustrated catalog, are available from Magnetic Video (South Pacific), North Point 100 Miller St, North Sydney 2060.

with other luggage, or thrown onto the back of a truck, without likelihood of harm. Identified as the MKE1000, the Sennheiser road case kit is available from R. H. Cunningham Pty Ltd, at 146 Roden St, West Melbourne, Vic 3033. Phone 03 329 9633.

PIONEER ELECTRONICS AUST PTY LTD have made the graphic equaliser one step more graphic by adding individual LED indicators to each of the 24 controls on their new model SG-9800 equaliser. The shape of the curve in each channel is displayed at a glance in an eye-pleasing red glow. But there are also a number of internal refinements, such as the virtual elimination of open wiring, input attentuation switching, LED overload indicator, muting with a relay to eliminate power-on transients, a signal noise ratio of 92dB and a THD that never exceeds 0.02%. RRP is $469. Pioneer is at 178-184 Boundary Rd, Braeside, Vic 3195. Tel. 03 90 9011.

3M AUSTRALIA PTY LTD have added a Scotch brand 543 micro dictating cassette to their product range. It is compatible with Sony, Olympus, Panasonic, Lanier and other microcassette recorders and provides a recording time of 30 minutes per side. 3M have omitted the usual leader tape to minimise the risk of over-running the oxide coating and have made the case of clear plastic to allow the label to be viewed without opening. Details from the Data Recording Products Division, 3M Australia Pty Ltd, PO Box 99, Pymble, NSW 2073.

R. H. CUNNINGHAM PTY LTD has produced a 72-page catalogue of its complete range of professional audio products. These include microphones, headphones, headphone/microphone combinations, test equipment, audio connectors, transformers, accessories and the new variable speech control cassette recorder. The catalogue is available to professional, government, and educational organisations on request. (R. H. Cunningham Pty Ltd, 146 Roden St, West Melbourne, Vic 3003. Phone 03 329 9633)

LAS VEGAS CES SHOW: Reporting on the show, technical staff writers for the US "Stereo Review" magazine say that there are signs that the hifi integrated amplifier power race has quietened down. While there are obvious exceptions to the rule, most model ranges cover between about 30 and 100W RMS per channel. Receivers tend to concentrate between the limits 20W and 75W per channel, again with exceptions.

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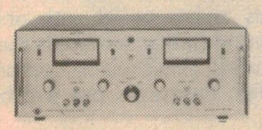
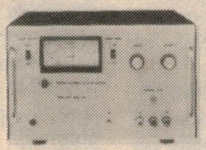
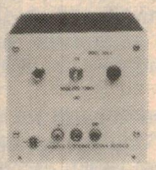


Dual Output — 6 models

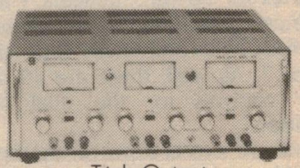


Single Output — 7 models

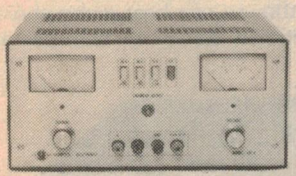


Modular — Single & Dual

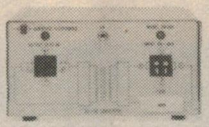
Microprocessor — Triple Output



Triple Output



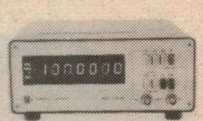
Triple Range — Universal



DC/DC Converters — 5 models

Switching Mode — 2 models

Custom Design — Volume Production



Frequency Counters — 2 models

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Apart from wide acceptance in general industry, Scientific Electronics power supplies are currently being used in many government departments, in crime detection, public transport, telecommunications, airlines and education.

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N.S.W., Electronic Developments, 438 2500.
S.A., Graphic Electronic Industries, 42 6655.
Qld., Fred Hoe and Sons, 277 4311.
W.A., W. J. Moncrieff Pty. Ltd., 325 5722.

Marantz PM700 DC Amplifier

has Graphic Equaliser and Led Power Meters

Incorporating a five-band graphic equaliser, moving coil preamplifier and LED Power Meters, the Marantz PM700 DC amplifier provides many useful features. Capable of more than 70 watts per channel into eight ohms and low distortion, the amplifier represents an attractive and powerful unit.

Marantz have been manufacturing high quality audio equipment for many years now and their experience in this field is indicated by the refinement of the PM700. With its well-finished front panel, symmetrical gold anodised controls and featuring a detented volume control knob, equaliser controls and LED power meters, the amplifier stands out as a refined product.

The PM700 is of medium size, with overall dimensions of 416 × 146 × 330mm (W × H × D) excluding knobs, feet and rear projections. Mass is 9.5kg.

Rotary controls are provided for the input selector, record out, volume and balance controls. There are 10 push button switches for Power, Speakers 1 and/or 2, Loudness, Equaliser Defeat, Mono, 20Hz and 9kHz filters and finally Tape Monitor 1 and/or 2. As well, there are 10 detented slider controls for the dual five-band equaliser.

There are two LED power meters, which are calibrated over the ranges of .008 to 90 watts into an 8 ohm load and from .016 to 180 watts into 4 ohm loads. There are 12 LEDs per channel and our tests indicated these to be accurate and fast responding. They are arranged in a linear horizontal row with the left channel display being above the right. As the power increases to the threshold of the next power indicating LED those indicating lower power remain on such that a band of LEDs glow in response to the signal.

On the rear panel, there is the usual array of RCA output sockets together with a DIN socket for tape deck connection. Separate preamplifier outputs and power amplifier inputs have been omitted.

Loudspeaker connections are made via shrouded terminals, which are a good safety feature. They minimise the chance of shorted connections and also isolate the user from the potentially high output voltages (potentially 30 volts RMS or more).

There is no mains earth for the PM700. Instead, it has a "double insulation" symbol on the rear panel which can normally be taken to mean that no earthing is required. However, we have some reservations as to whether the amplifier would meet Australian standards for double insulation, in every detail. There is a GND terminal for the inputs, should this be required.

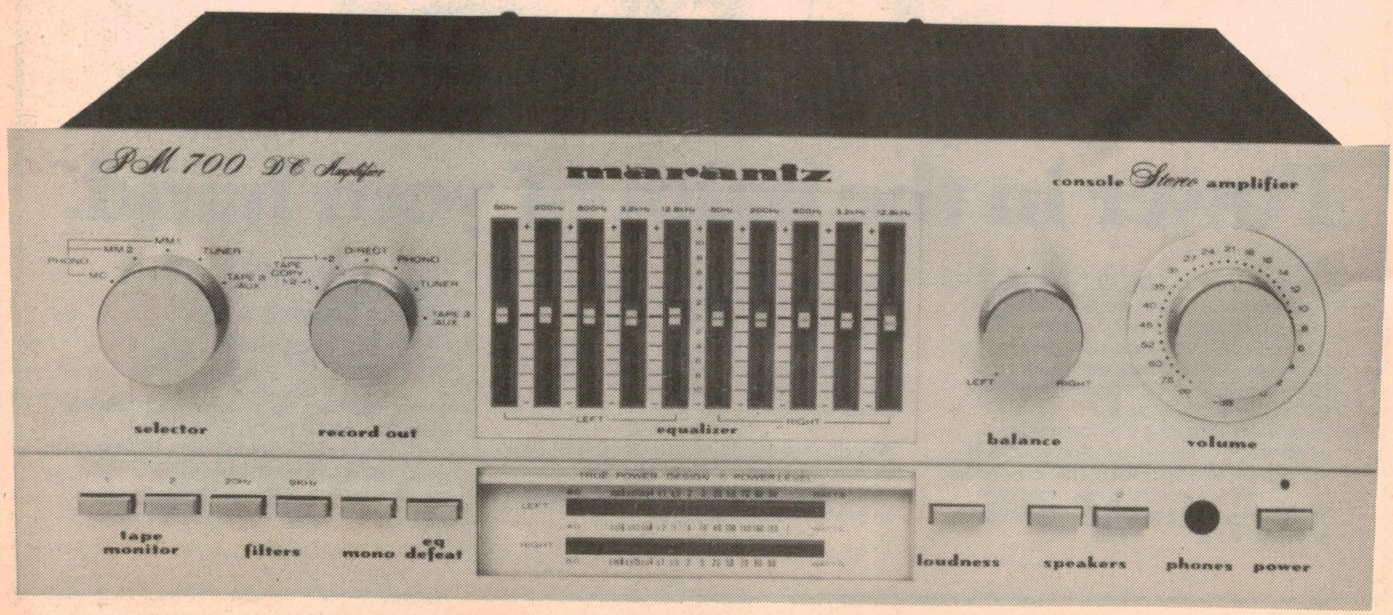
Removing the cover of the amplifier reveals a neat interior with some engineering innovations. There are 10 PC boards in all and eight of these are to reduce much of the wiring and hence labour content in the unit. One PCB directly mounts the volume and balance potentiometers and another is directly behind the RCA and DIN sockets and wired to the amplifier board with ribbon cable.

The record out and input selector switches are actually located on the preamplifier PCB and controlled via remote control mechanical guides to the external switches.

The preamplifier PCB contains four low noise ICs and a separate regulated power supply. The Loudness, 20Hz and 9kHz Filters are located on PCBs adjacent to their switches and similarly is the LED power meter circuitry located behind the display.

Two boards are provided for the equaliser circuitry. One PCB holds the slider controls and is wired with ribbon cable to a second PCB which holds the active filter circuitry. This circuitry comprises one IC and five transistors per five band channel.

The most striking feature of the internal layout is the use of a heat pipe rather than a conventional diecast or extruded heat-



sink. Whether or not it really is a heatpipe in the strict sense of the word we do not know. Marantz make no mention of it in their literature, which is a little surprising. The fact that the pipe is a continuous loop suggests that this is merely a liquid cooling system working by simple convection rather than a two-phase system, ie, liquid/gas.

We began our performance tests of the PM700 with the standard one-hour preconditioning, with both channels delivering 40% of rated power. This resulted in the heat pipe temperature rising to 75 degrees Celsius with an ambient temperature at around 20 degrees Celsius. This indicates that the heat pipe operation is more than adequate for normal use.

Marantz rate the PM700 power output at 70 watts RMS per channel, with both channels driven into 8 ohm loads for a distortion of 0.025% over the frequency range 20Hz to 20kHz.

We measured 83 watts per channel with both driven into 8 ohm loads, at the onset of clipping. With 4 ohm loads, the power was 116 watts per channel with both driven. With 16 ohm loads, the power output was 60 watts.

At 20kHz, the harmonic distortion at rated power was 0.1% being above that of the specification of 0.025%. The harmonic distortion reduced at lower frequencies until at 1kHz the figure matched that of specification. At half power, the harmonic distortion was typically 0.02%.

Intermodulation distortion measured with 50Hz/7kHz signals in a 4:1 ratio was 0.037% into 8 ohms, higher than the specification of 0.025%, but still very acceptable.

Frequency response at one watt into 8 ohms is flat from DC to 60kHz where the response if 1dB down. With the 20Hz and 9kHz 6dB/octave filters in operation, the response is 3dB down at 20Hz and 9kHz. Clearly the 9kHz is for reducing record scratch and hiss noises.

Although the 20Hz filter provides a tapering of the response below 20Hz at 6dB/octave, this is not really adequate.

Whatever the arguments in favour of DC amplifiers, it is apparent to us that a sharp cut-off filter is needed for frequencies below, say, 20Hz, for phono inputs. Without the filter, the amplifier responds to every ripple in the record surface and the loudspeaker cones can dance about alarmingly as a result.

Phono sensitivity was 1.4mV for the moving magnet input and 0.4mV for the moving coil input for 83 watts output at 1kHz. Signal to noise ratio with respect to 10 watts and 10mV was 65dB unweighted, with a typical cartridge connected. Separation at 1kHz was 53dB.

Signal-to-noise ratio for the auxiliary and tuner inputs was 71dB with respect to 10 watts. Separation was 40dB at 10kHz, 64dB at 1kHz and 75dB at 100Hz. The sensitivity for 83 watts output was 170mV.

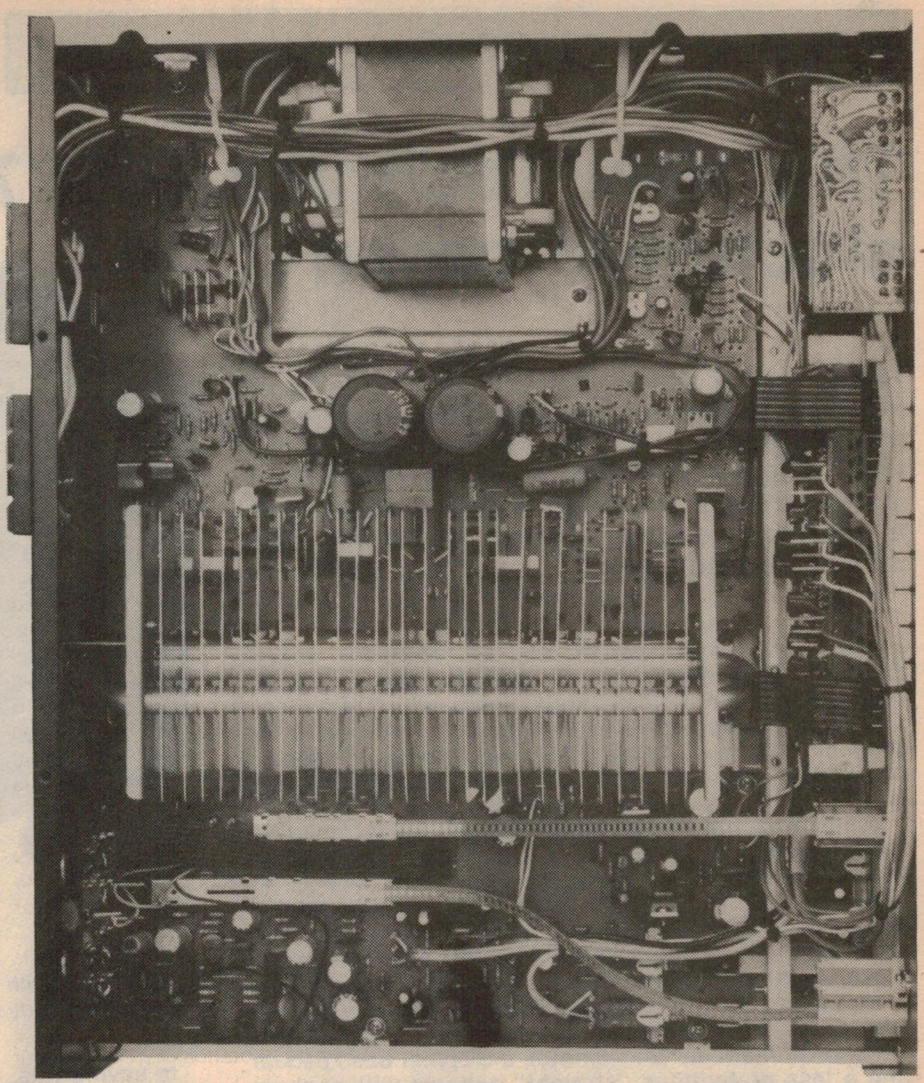
The loudness control provides a valley shaped frequency response with boost applied at the high and low ends of the audible frequency range. We measured +9dB at 10kHz, +10dB at 500Hz and rising to +20dB at 20Hz. These were measured at a volume knob reading of -65dB. The boost available from the loudness control is progressively reduced at higher volume settings until a flat response occurs at 0dB or at full volume.

The graphic equaliser controls provide about an 8dB boost or cut at 50Hz, 200Hz, 800Hz, 3.2kHz and 12.8kHz. This amount of boost and cut does not quite agree with that marked on the front panel. However, the equaliser proved to be quite effective and gives a wider range of control than normal tone controls.

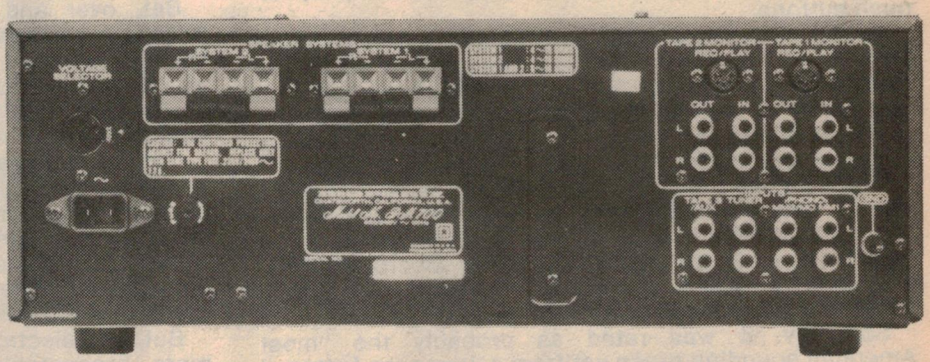
RIAA equalisation is rated at within ±0.25dB from 20Hz to 20kHz, but we measured this to be only within 1dB. This specification is still a reasonable figure.

Listening tests confirmed the general high performance standards of the Marantz. It has certainly plenty of power, is quiet and operates without any problems. It is a most attractive unit which is sure to appeal to a wide range of buyers. Recommended retail price is $599.

Further information on Marantz equipment can be obtained from high fidelity retailers or Marantz (Aust) Pty Ltd, 32 Cross Street, Brookvale, NSW 2064. (JC).



Notice the liquid cooling system for the output transistors. This provides a larger heat dissipating capacity than possible with a conventional heatsink.



The new Technics SX-7700G electronic organ

Following our review, last month, of the Wersi kit organ, we were most interested to be given the opportunity of a hands-on evaluation of the new Technics SX-7700G. A beautifully finished instrument, it provides an eloquent example of a marriage between modern electronic and musical technology.

As we mentioned last month, the "National" brand name is being phased out of the organ market having been replaced, in the new model range, with "Technics" — a highly respected name in the quality hifi market. At the top of the range is the SX-5E, as pictured on page 18 of our May issue. It has been priced at just under $10,000, which is more than most of us have to spare!

When National Panasonic (Aust) offered to make an SX-5E available to us for evaluation and review, we opted instead for the top-of-the-line spinet model SX-7700G. At about half the price of the SX-5E, and without the full pedal board and fixed stool, we felt that it would be a more typical home instrument than the SX-5E and more closely related to models lower down in the price range.

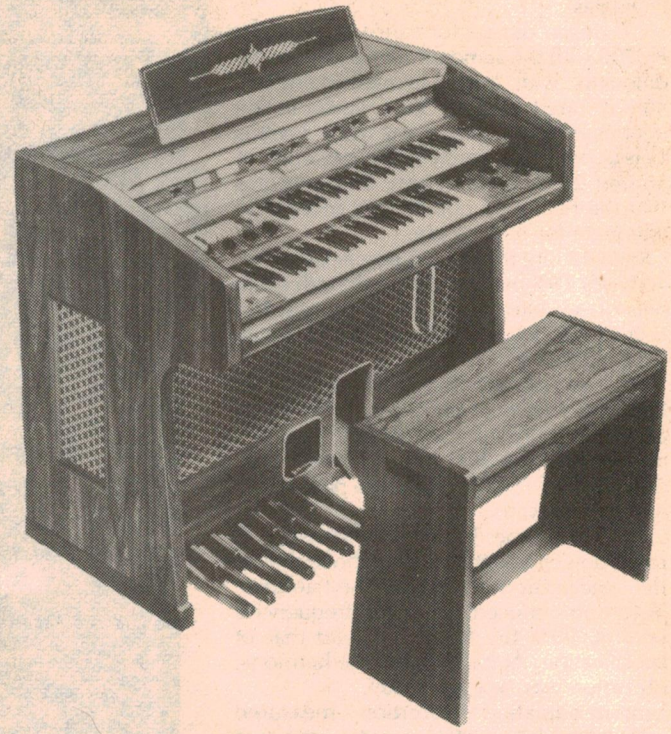
No less to the point, the SX-7700G shares most of the features of its big brother, the economies being mainly in the shorter manuals (2 x 49 note), the spinet bass pedals and a less pretentious "straight" console with rockers rather than tongue tabs. But most everything else is there, with an attendant checkerboard of colour-coded push-buttons.

In fact, the array of tabs, buttons and levers tended to bewilder at first encounter. To make matters worse, the instrument delivered to us was a production sample with a clip full of photostat pages in lieu of the expected glossy user-manual. But, once we began to get the hang of it, the logic of the layout began to come through.

While we had the instrument on hand, several organist friends took the opportunity to make its acquaintance and, over numerous cups of tea, to philosophise about its design — in the electronic sense. Mechanically, it was never in doubt, gaining full marks for beautifully finished cabinet work, keyboard "feel" and so on.

Sonically, it was rated as probably the "most American sounding organ yet from a Japanese factory." To most Australian enthusiasts, this can only be a commendation. There are no squeaky voices, no zizzy strings, no buzzy reeds, even with the tone at its brightest setting. My first reaction was that the evident conservatism might even have been overdone but, against this, came the realisation that the instrument could not readily be induced to produce harsh or unpleasant tones, even in the hands of a beginner.

One reason for this is that the foundation "flute" stops on both manuals sound much purer than the usual bulk-filtered square waves and, in this respect, they are strongly reminiscent of the tone-wheel Hammonds. This fact, plus the nature of the imitative sounds, would suggest that the designers of the 7700 (and doubtless the SX-5E) have not sought to economise in the filters.



The SX-7700G, with keyboard lid slid back out of sight. Cabinet finish is in a slightly reddish, matte walnut.

In saying this, I am assuming the use of divider type circuitry, square and staircase waveforms and formant filtering. No circuit information was available.

But, over and above the "American sound," the SX7700G expresses a design philosophy which has become apparent during the past four or five years and which applies to most of the popular brands now available. It is, in fact, the subject of comment in a club publication currently circulating in the Sydney area.

Up till a few years back, an electronic organ tended to be judged primarily on its ability to simulate its acoustic counterpart — a church pipe organ on the one hand, or a Wurlitzer-cum-Christie on the other. Whether their owners could emulate either in terms of music content and playing style was beside the point; it had to be capable of sounding like a "real" organ!

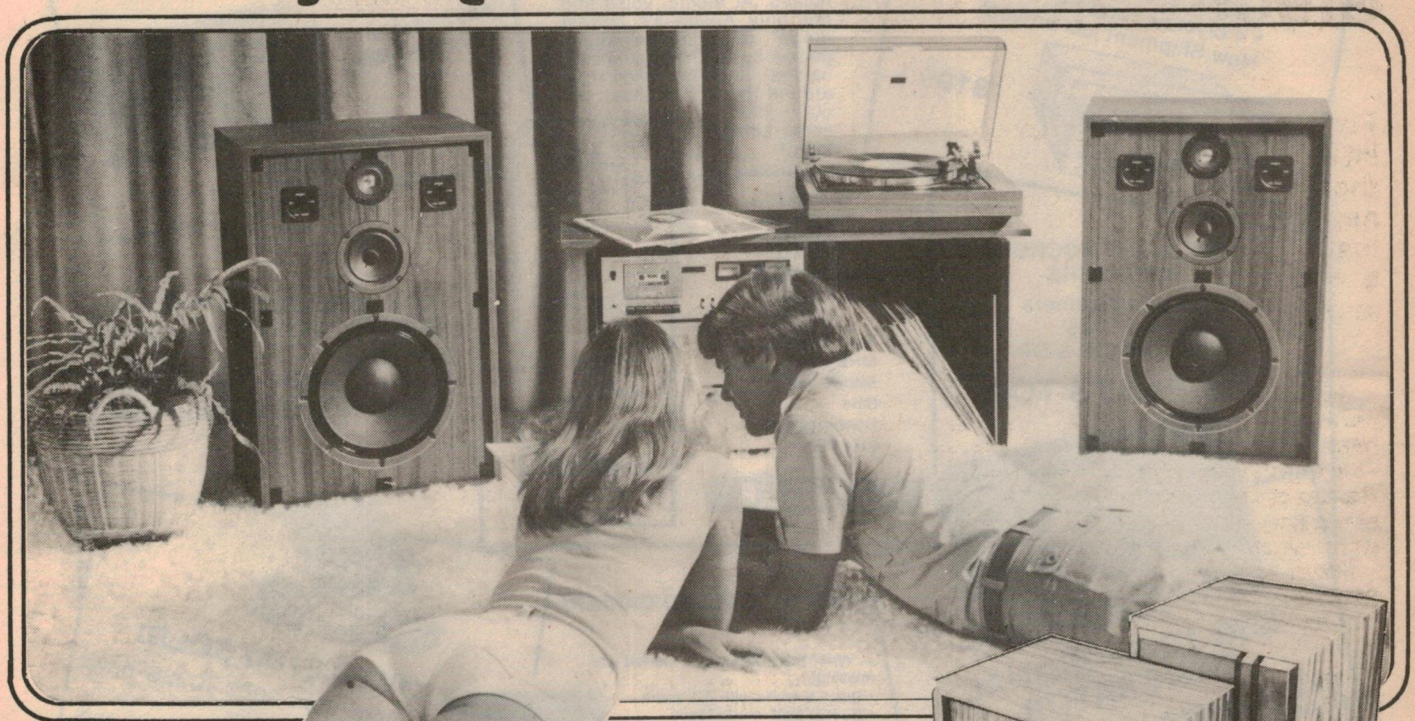
But, with electronic music-making generally becoming more "respectable," electronic organs are being seen more as instruments in their own right. In terms of market share, a new prime requirement has emerged: to produce an instrument which will be as pleasing and versatile as possible in the hands of an expert musician — or as "co-operative" as possible with those having limited skills.

Thanks to modern electronic technology, those two rather diverse objectives can be merged.

We understand that the ultimate Technics range will embrace a dozen or more models with widely varied emphasis but the first six to appear are aimed primarily at what is now seen as the majority market — home, club and stage entertainment.

To be sure, the "Seventy-seven-hundred" can be played without vibrato and trem. in the manner of a

The rewards for 2 hours of your time: a feeling of accomplishment, beautiful speakers and YOU SAVE



Photograph shows speakers without front grilles.

By assembling these speakers yourself you'll own far better speakers than you could have otherwise afforded (you save high labour costs) and you end up with a superb system that will delight you and your family.

TERMS are available to approved personal shoppers from a low 10% deposit and low monthly repayments.

Playmaster

SAVE $100* or more

Each of the three Playmaster speaker kits were acoustically designed by Neville Williams (MIREE), Editor-in-chief of Electronics Australia magazine. They are precision manufactured by Dick Smith so that everything just about 'falls into place'. The four side panels are pre-joined to the vinyl cladding - they simply wrap around the front baffle board. Even if you've never built anything before, you can make a pair of these magnificent speakers in about 2 hours construction time.

The 6 page, profusely illustrated instruction brochure explains everything in a simple, step-by-step manner. Even a child can do it!

*Based on the price of the 300mm system in ready built form.

Specifications	200mm	250mm	300mm
Speaker Enclosure:	26 litre, infinite baffle	53 litre, infinite baffle	75 litre, infinite baffle
Dimensions in cm:	53.5(h)x32(w)x22.6(d)	62(h)x39.3(w)x29.3(d)	71.7(h)x47.5(w)x29.3(d)
Frequency Response:	45Hz - 20kHz	35Hz - 20kHz	28Hz - 20kHz
Impedance:	8 ohms	8 ohms	8 ohms
Power Rating:	40 watts music	60 watts music	80 watts music
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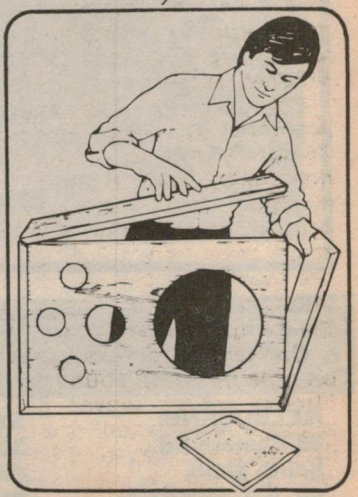

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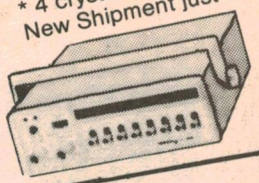

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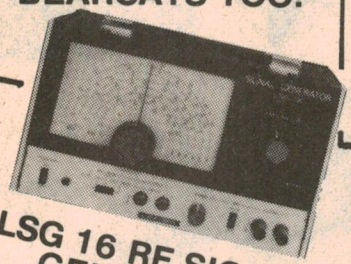

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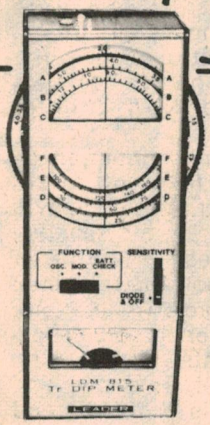

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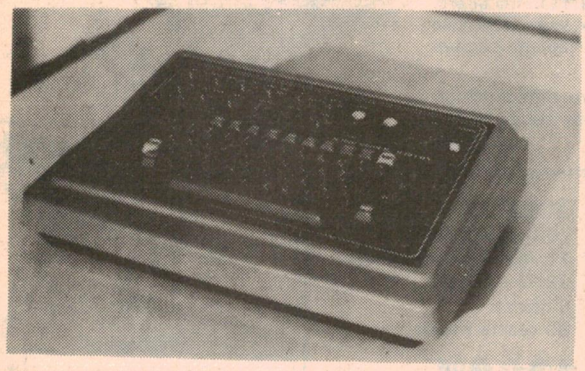

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church organ, but its forte is as a "fun" machine — using the term in its broadest sense. Some of us, with limited skills, had fun; a pianist friend had fun; but so also did well known Sydney organist, David Parsons, who remained glued to the stool for a couple of hours one evening, exploring the voices, the effects and the electronic skullduggery!

In the space available here, it is simply not possible to explain or list all the features in the SX7700-G; even in the 30-plus photostat pages referred to earlier, they were covered only sketchily. Readers who want formal specifications of the 7700 or other instruments in the range can get in touch with: The Manager, Technics Organs, 95-99 Epping Rd, North Ryde, NSW 2113; or through PO Box 319, North Ryde, 2113.

In broad terms, voices for the upper manual can be selected by a row of rockers, ranging from 16ft to 2ft. These can be supplemented by a string ensemble, by a piano-like percussive attack and by a "harmoniser." A row of selector buttons give further access to two preset organ combinations and to realistic solo instruments: saxophone, accordian, piano, harpsichord and vibraharp.

The "harmoniser" referred to above serves as an easy-to-use synthesiser for wind instruments, allowing the player quickly to set up clarinet, trumpet, trombone, etc, with adjustable formant. Auto "wah" is available, and repeat wah with adjustable speed. Footage can also be dropped to 16 and sound created which smack more of a synthesiser than any conventional instrument.

There are rockers for decay and sustain, the latter being fully variable. Sustain is also brought out to a knee swell, allowing controllable sustain on organ, but more importantly, on piano and vibraharp.

The usual vibrato facilities are available, with "delay" for instrumental solos.

But what really impresses is the "tremolo" which substitutes for the usual mechanical Leslie speaker. The tremolo speed can be varied and, when set to the usual 7Hz (approx), it "speeds up" much like a Leslie system. It is every bit as effective, without the limitations of a mechanical device. No less important, it can be switched individually or simultaneously to the upper flutes, upper orchestral, or lower manual, and enriched by a "Chorus" effect.

One other voicing feature warrants special mention. A "Celeste" rocker overrides the tremolo and splits the sound three ways into three amplifier/speaker systems (100W + 50W + 50W) each differently phase modulated. A more spacious sound in a small room, you're unlikely to hear!

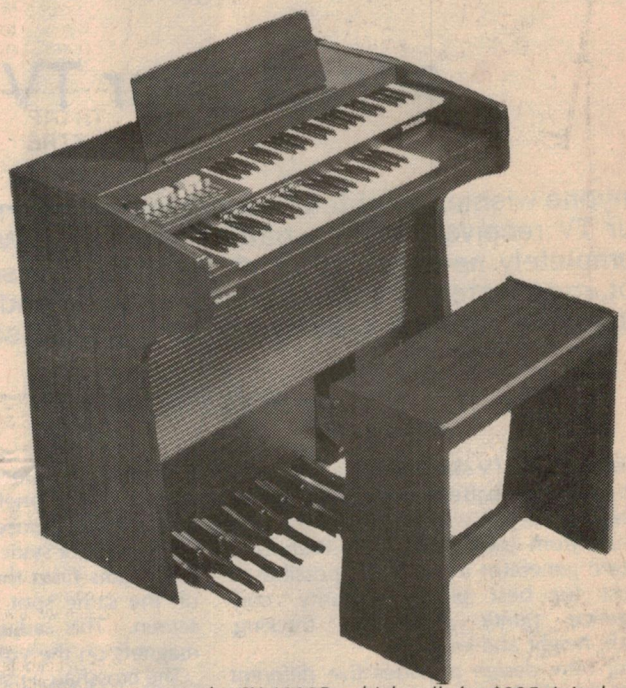
The lower manual has 8ft and 4ft voices, plus sustain, its own string ensemble, and provision for manual balance. For supportive and fill-in work, the voicing is excellent. Arpeggio is also available, plus coupling down to the bass pedals.

Indeed it is in the bass department where technology really takes over, especially when it gets involved with the auto rhythm.

Fundamentally, the player is provided with 16ft and 8ft organ tones, reinforced by pedal celeste. But he/she also has available a most impressive brass band style tuba and a bass guitar. While normally played with the pedals, it is possible to play the notes from the lower manual, either as a bass solo or in conjunction with the manual voices. Or the player can interchange them to tempo, by operating the "full bass" pedal alongside the swell.

One of my visitors voted the auto rhythm as "possibly the best in the business." It provides a dozen basic rhythms, which can be used single or in combination, plus fill-in and start rhythms, variation, and auto-variation — the latter changing the rhythm pattern every eight bars. Start and stop is available via a touch switch, by synchro off the bass pedals or lower manual, or via a switch on the swell pedal which, serves for "glide."

The rhythm can be used separately and/or used to trigger arpeggio on the lower manual, and full automatic walking bass, in alternative degrees of complexity.



Baby of the range is the SX-1800B, which sells for $995. It includes rhythm generator and auto play chord.

Add all this and you can seat a person at the organ who has never played anything in their life but a piano or harmonium. Press the right buttons and they can "do their thing" to a complex rhythm accompaniment and full walking bass.

And so it goes on. It seemed that everyone who sat down to the 7700 came up with a sound or a gimmick that we hadn't noticed before!

Two other facilities warrant special mention, both employing computer/memory technology.

One, called a "Programmed rhythm computer" permits an experienced musician to compose and store a couple of 3-bar or 4-bar rhythms in addition to the presets. The full drum kit is accessable.

The other, a "Programmed chord computer" allows a novice to store, at their leisure, up to 32 chords to provide the left hand accompaniment for a particular melody. The organ will then play those chords back in a selected tempo, adding bass, walking bass and arpeggios as desired. All that is left for the player is to insert a 1-finger melody line on the top manual!

Ah yes; one other point: the apparent smoothness of the 16ft bass caused me to wonder what tricks of baffling Technics had pulled. But there was nothing out of the ordinary to be seen; just a light removeable back to the console, a 30cm speaker, a tiny tweeter and two 20cm drivers to cope with the available 200W of power. The speakers had obviously been "tailor made" for the job.

And what does the SX7700-G cost? Just under $5000 . . . $4995 to be precise. For that you get a very clean sounding, entertainment style electronic organ, with everything on it that opens and shuts! (W.N.W.)

Crystal-controlled TV pattern generator

adjust your TV for a first-class picture

Anyone wishing to obtain the maximum performance from a colour TV receiver needs a pattern generator. Why not build this completely new design which provides five separate patterns: dot, crosshatch, checkerboard, grey scale and white raster. Using just 12 ICs and a 4MHz crystal it should sell for under $50.

by RON DE JONG

Now that the TV stations rarely broadcast test patterns, a pattern generator is almost mandatory if you wish to obtain the best picture from your colour set. Without a pattern generator it is just not possible to adjust for best picture linearity, convergence, purity, grey scale tracking, width, height and so on.

Our new design provides five different patterns which allows virtually all of the adjustments likely to be required on a typical colour set to be performed. Colour patterns have not been provided as this would have markedly increased the cost for a relatively small gain in utility.

Let us give a brief rundown of each pattern and its purpose. The dot pattern is for adjustment of static convergence whereby the beams from the three guns converge on the same spot in a given part of the screen. This adjustment is made via magnets on the yoke assembly.

The crosshatch pattern consists of 14 vertical lines and 12 horizontal lines. This pattern can be used to check and adjust picture geometry (width, height, horizontal and vertical linearity) and dynamic convergence. Dynamic convergence is a measure of how well the three beams converge to a single line at any position on the screen.

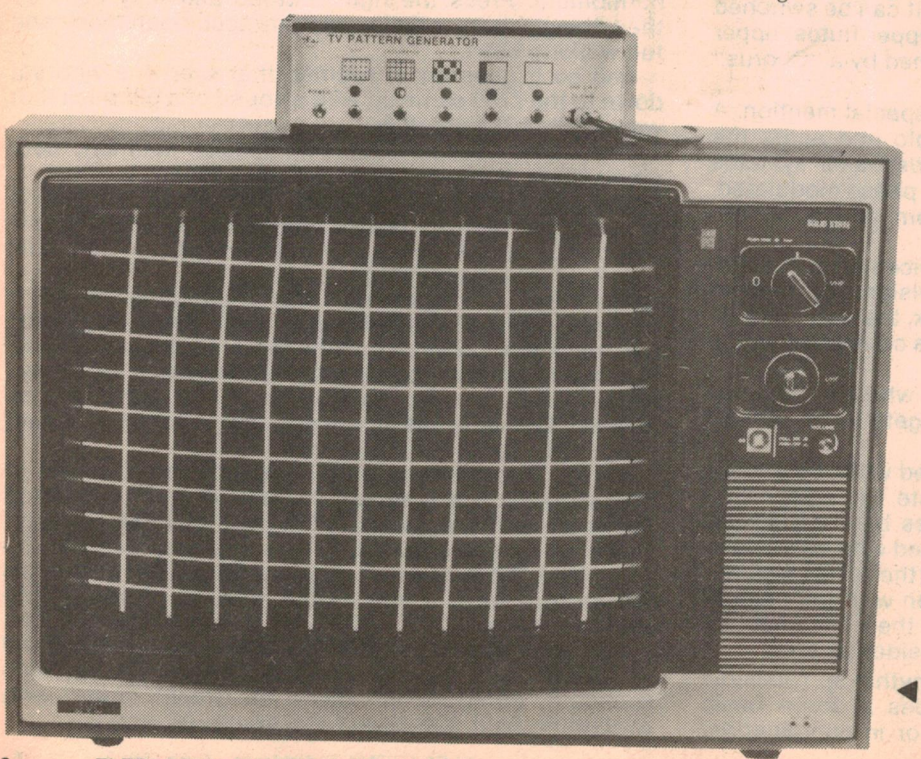
The new colour sets with vertical slot tubes and "self-converging" yokes have inherently good dynamic convergence and few adjustments. The older sets with delta-gun configuration and a triad dot phosphor pattern have much poorer dynamic convergence and up to 20 convergence controls.

The checkerboard pattern can also be used to demonstrate poor convergence with the margins between black and white areas showing as a colour "fringe". This pattern also clearly displays poor picture geometry and inadequate low frequency response in the receiver video stages. This latter problem is revealed by "smearing" of the pattern.

Finally, the pattern generator provides a white raster signal which can demonstrate picture purity. Any problems in this regard will show up as areas of colour tint on the screen. This could be the result of magnetisation of the tube metal surround which should not be the case if the automatic degaussing circuits are working correctly.

Seven vertical bars grading from black to peak white make up the grey scale. This pattern is used to check that the picture provides a full range of contrast and good "grey scale tracking". The latter is a measure of any colour tinting effect which may occur at different levels of picture brightness. In severe cases of poor grey scale tracking, the picture appears to change colour as the brightness level varies.

As well as providing the five patterns, our new generator provides for electronic pattern selection. This elegant method simplifies the wiring and generally improves the performance on each separate pattern by minimising "crosstalk" in the generator circuitry.



◀ *Left: the crosshatch pattern is particularly useful for checking and adjusting picture geometry and dynamic convergence.*

Furthermore, since all the circuitry is crystal-locked, there are no setting up adjustments and no need to obtain access to the internal circuitry of the TV receiver. Just connect the 75-ohm unbalanced output from the generator to the TV antenna terminals and away you go. All that for just a few hours work and less than $50 outlay.

With all these features the pattern generator is still quite a straightforward circuit. Fig. 1 shows a simplified block diagram of the generator and the various video and sync waveforms generated at different points in the circuit. The heart of the circuit is the 4MHz crystal oscillator from which all the other signals are derived, including the video pulses for the vertical and horizontal lines in the crosshatch pattern and the horizontal and vertical sync and blanking pulses.

In the Australian TV system there are 625 lines in each complete picture or "frame" and 25 such frames are transmitted per second. To reduce flickering each frame is actually transmitted as two fields each of 312.5 lines with the second field interlaced with the first to give a total of 625 lines. To simplify the circuitry of the pattern generator we have used random interlacing with 312 lines per field and 624 lines total in a frame. In practice; random interlace has no effect on the quality of the patterns and is nearly always used in pattern generators, video games and video terminals.

From the foregoing, it follows that the field (or vertical deflection) frequency is 50Hz and the line (or horizontal deflection) frequency is 15,625Hz.

Random line interlace is the result of much simplified horizontal and vertical sync pulse trains – to keep the circuitry simple. As indicated above, this is in line with common practice in typical video games and computer video terminals. So in this circuit, the horizontal sync pulses are 4us long at the rate of 15,625Hz and the vertical sync pulses are 512us long at the rate of 50Hz. The circuit also generates blanking pulses although these are not shown in Fig. 1.

Now getting back to how these signals are derived, the 4MHz clock is first divided by 16 to give a brief pulse 0.25us long every 16 × 0.25 or 4us. This provides vertical lines which are part of the crosshatch pattern. This signal is then further divided by 16 to give a horizontal sync pulse 4us long every 16 × 4 or 64us which, of course, is precisely the correct line frequency, since 1/64us is 15,625Hz!

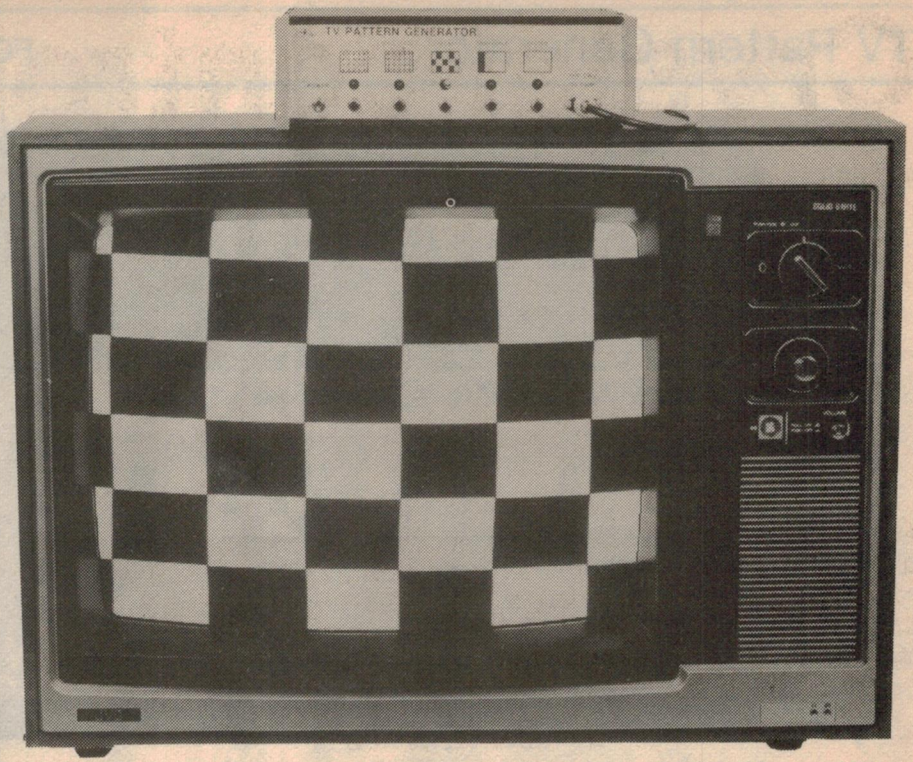
The sync pulse is then further divided by 26 to give a signal which is high for one line (64us) every 26 lines. These are in fact the horizontal lines which make up the crosshatch pattern and the reason we have chosen this apparently strange line spacing is so that the crosshatch has the correct aspect ratio of 4:3. That is, the crosshatches will appear square when the height and width controls of the TV set are properly adjusted.

Finally the signal is divided by 12 to generate the vertical sync pulses. As you have probably realised 12 × 26 is 312 which is precisely the number of lines per field required. One point that does emerge though, is that since we have 312 rather than 312.5 lines per field the field frequency is 15,625/312 or 50.08Hz, not 50Hz. The difference is negligible of course.

Referring now to the circuit diagram only 11 readily available CMOS ICs have been used, plus a 12V regulator. IC1a is a simple crystal "PI network" oscillator with a 10M bias resistor. Output from the oscillator goes to IC2 which is a 4040 12-stage CMOS binary divider. The first four outputs are decoded by IC3a, a 3-input NAND gate, and IC5a, a NOR gate to generate the vertical crosshatch lines, 0.25us long every 4us.

The binary outputs Q6 to Q8 of IC2 are then decoded by IC3a which is another 3-input NAND gate. This generates a pulse 8us wide very 64us which is the horizontal blanking pulse. This is further combined with Q5 by NOR gate IC5d to give a horizontal sync pulse 4us wide. Due to the slight propagation delays of the gates we have used a simple RC network at the output of IC5d to remove any "glitches".

As depicted in the block diagram, the Q9 output of the 4040 divides the line frequency by two which is then further divided by 13, by IC4b which is one half of a dual 4-bit binary counter. Of course a



The checkerboard pattern can be used to demonstrate poor convergence, poor picture geometry, and inadequate low frequency response in the receiver video stages.

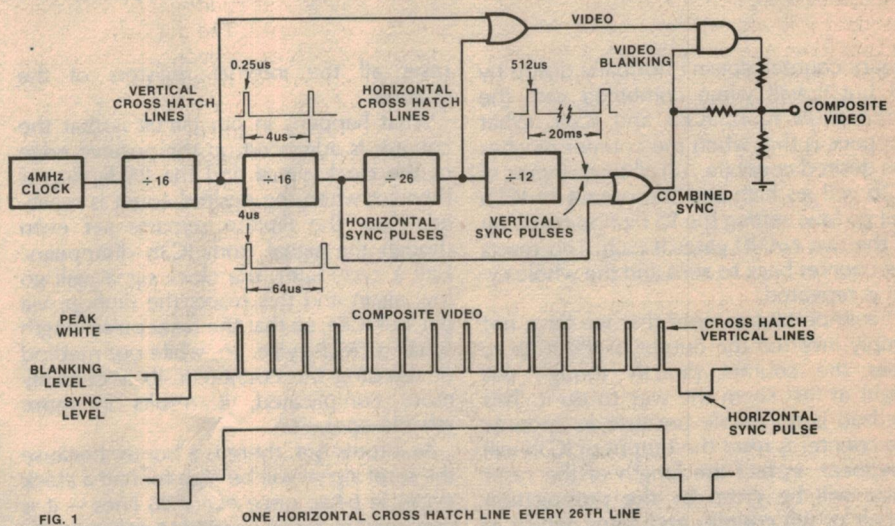
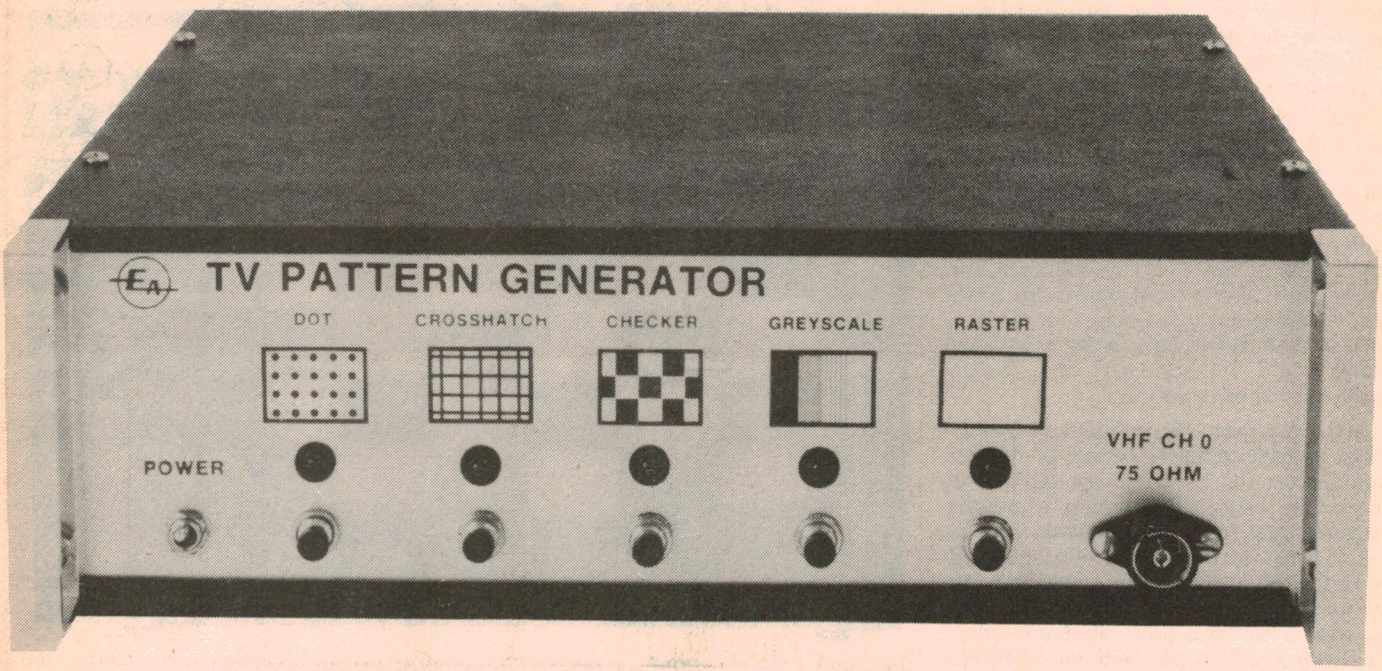


Fig. 1: simplified block diagram of the TV Pattern Generator, together with the various video and sync waveforms at different points in the circuit.



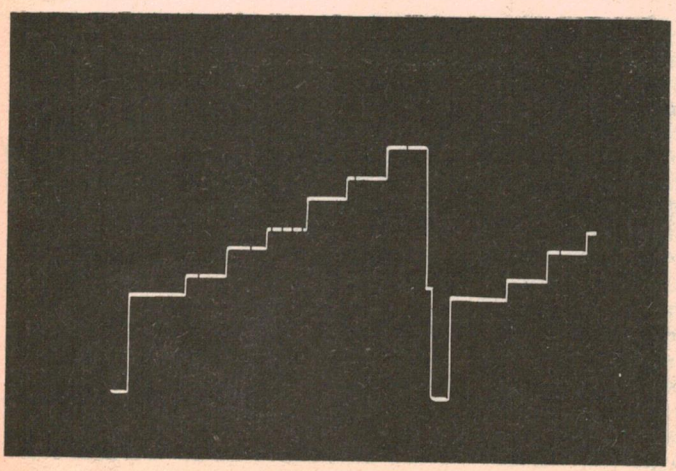
The new generator provides five separate patterns and features electronic pattern selection.

binary counter doesn't normally divide by 13 but it will when combined with the three gates IC3b, IC8b and IC8a. What happens is that when the counter reaches the desired count (ie, 13) all three inputs of IC3b will go high and the output of IC3b will go low, setting the RS flipflop made up of the two NAND gates IC8a,b. This resets the counter back to zero and the whole cycle is repeated.

It is important to note that we have not simply inverted the output of the IC3b to reset the counter directly though this might at first seem the way to do it. This method is unreliable because as soon as the counter is reset the output of IC3b will disappear; in fact the length of the reset pulse will be given by the propogation delays of the counter and gates, which in some cases could be too short to reliably reset all the internal registers of the counter.

What happens in our circuit is that the counter is advanced on the positive edge of the clock signal and the RS flipflop is then set when the desired count is reached. Now the flipflop remains set even though the signal from IC3b disappears. Half a cycle later, the clock signal will go low again and this resets the flipflop, via pin 1 of IC8a; so that the reset pulse length is half a clock cycle. So, while our method of resetting the counter IC4b is certainly more complicated, it results in more reliable operation.

As it turns out, there is a bonus: because the reset signal will be high for half a clock cycle, ie 64us, once every 26 lines — it is precisely the signal needed to generate the horizontal lines in the crosshatch pattern!



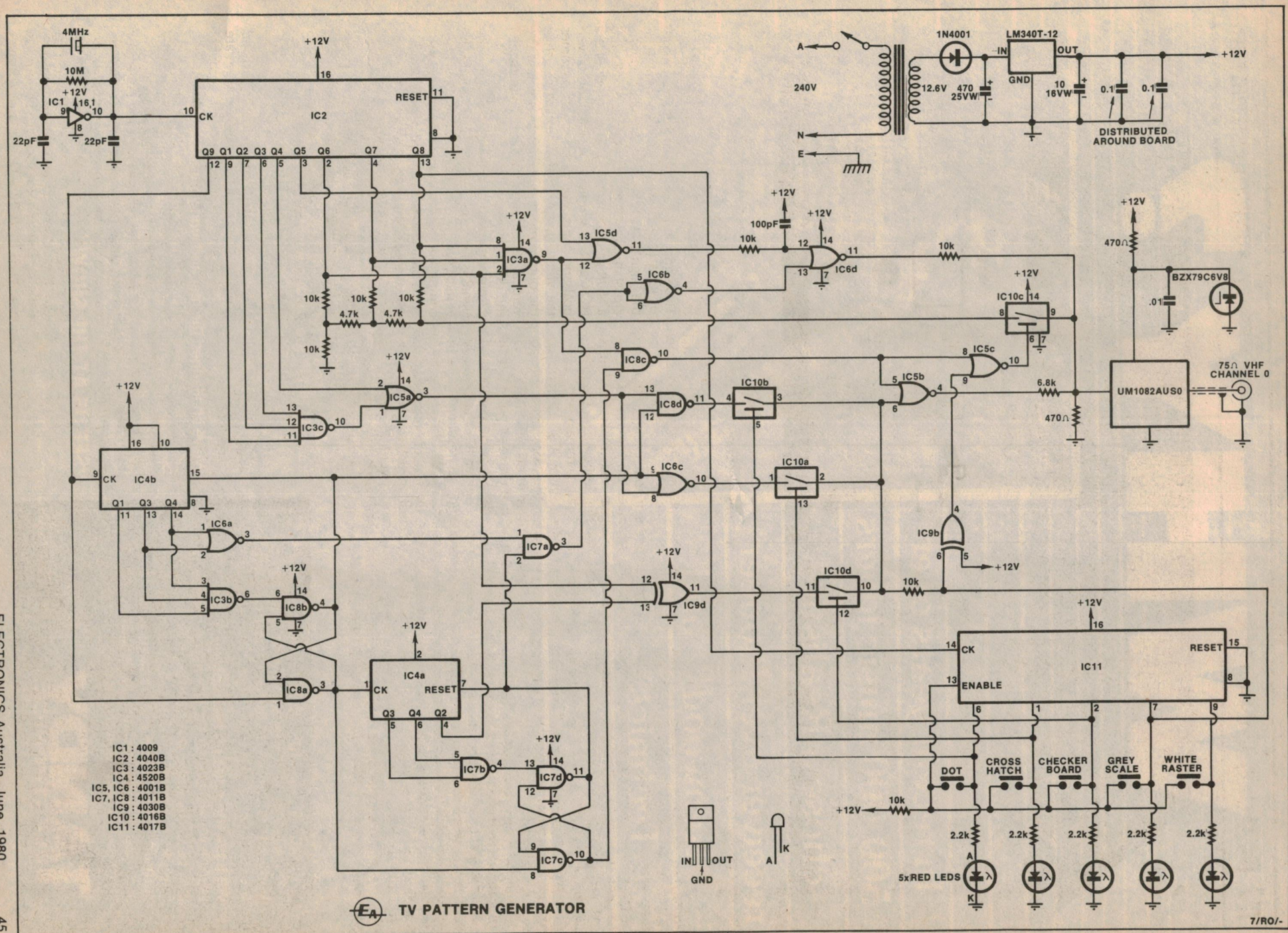
This photograph shows the final composite video waveform for the grey scale. Note that the sync pulse is followed by the back porch and a seven-step staircase waveform to give the seven vertical grey scale bars.

This signal is in fact mixed with the output of IC5a (which, as you will remember, is the signal for the vertical lines in the crosshatch) by IC8d and IC6c, a NAND and a NOR gate respectively. The output of the NOR gate is simply a combination of vertical and horizontal lines so this becomes the video signal for the crosshatch while the output of the NAND gate is where the vertical and horizontal lines coincide, ie, the dot pattern.

Referring again to the block diagram, the signal is now divided by 12 to obtain the vertical sync and blanking pulses. This is accomplished by IC4a which in operation is quite similar to the previous divider. In this case, though, the correct count is detected by IC7b and the RS flipflop is made up of IC7d and IC7c, both NAND gates. Since the clock signal to this stage is low for one line and high for 25 lines, the output of this divider will be a pulse which is low for 25 lines and high for the remaining 287 lines in the 312 field. This pulse is the vertical blanking interval.

The vertical blanking pulse is ANDed with the output of IC6a to then generate the vertical sync pulses. Since the output of IC6a is high for only eight lines during each 26 line period the sync pulse will be eight lines long or 512us, and it will occur at the start of the vertical blanking interval.

So far all the signals to get the generator running have been produced. It only remains to combine the various signals to build up a composite video signal for the remaining patterns. (We have already seen how the crosshatch and dot patterns are made). The checkerboard pattern is generated by IC9d which is an exclusive-



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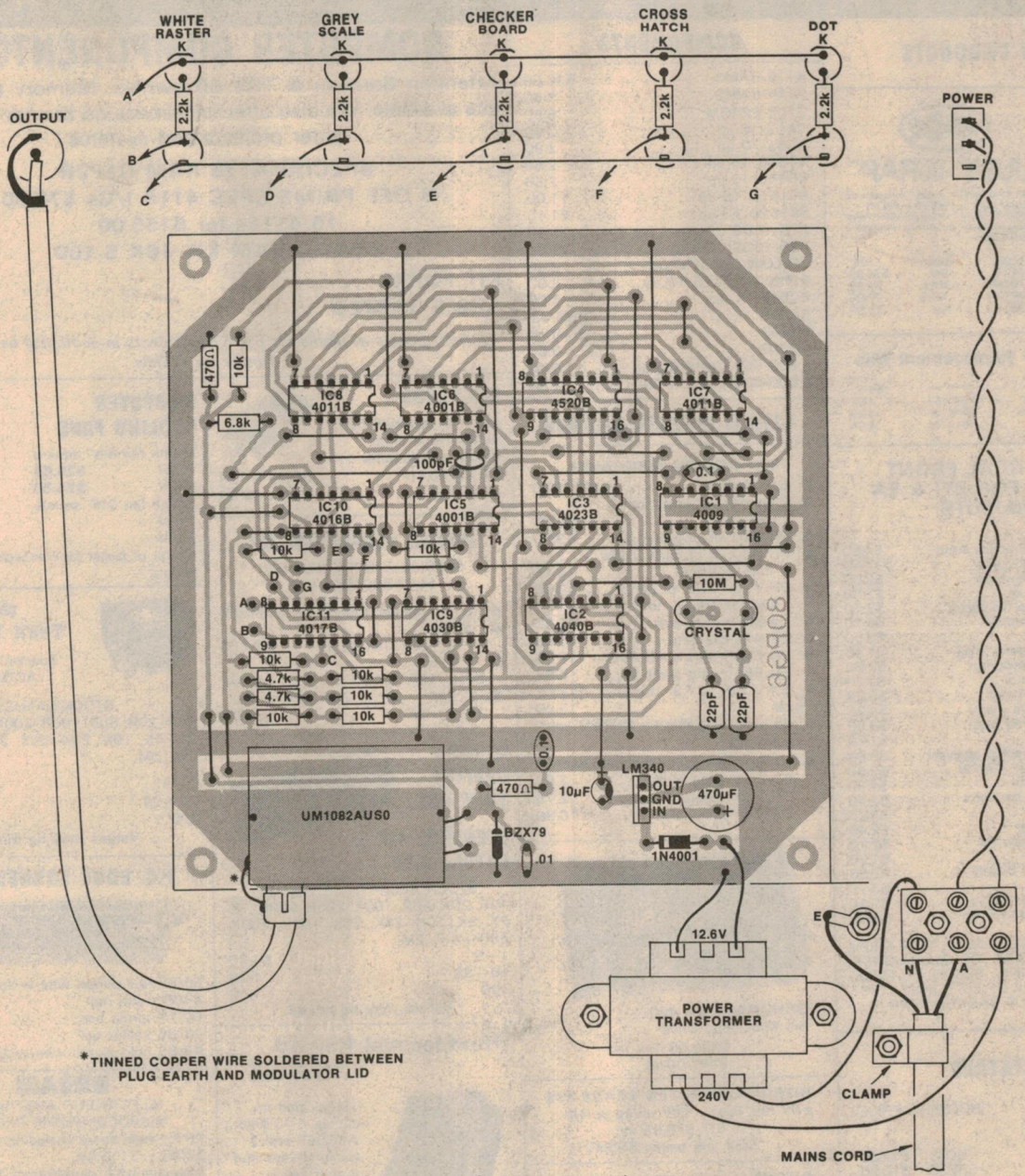

Follow this overlay diagram in conjunction with the circuit when wiring up the TV Pattern Generator.

OR gate with one input from Q6 of IC2 and the other from Q2 of IC4a. When Q2 is low IC9d acts as a non-inverting gate, passing Q6 directly; but when it is high the signal from Q6 will be inverted. Now since Q6 (IC2) is a square wave with a 16us period and the Q2 signal from IC4a is a square wave with a period of 4 x 26 = 104 lines, the pattern generated will consist of alternating black and white squares 8us × 52 lines.

The binary outputs of IC2, Q6 to Q8, drive a simple ladder type D-to-A converter to generate eight equally spaced voltage steps for the grey scale. This signal is fed to pin 8 of IC10c, a bilateral switch.

Vertical and horizontal sync pulses are mixed by IC6d and the vertical and horizontal blanking intervals are combined by IC8c. The combined blanking pulse turns the video signals from IC10c and IC5b off during the sync and blanking intervals.

The various patterns available (crosshatch, dot, checkerboard, greyscale or white raster) are selected by the electronic switching circuitry which comprises IC10 and IC11. IC11 is a 4017 decoded decade counter which is simply a one to 10 counter in which only one of the 10 outputs can be high at a time and they turn on in sequence as the counter is clocked. For most of the time, the counter is disabled by the 10k pull-up resistor connected to the enable input, pin 13 of IC11.

Five of the outputs are connected to front panel momentary contact switches and five LEDs arranged underneath the patterns each switch represents. Since only one of the outputs can be high at any time, one only of the LEDs will be on. Now if the momentary contact switch for another pattern is pressed the enable line will be pulled low because that particular counter output would be low. This enables the counter which is then clocked by the line sync pulses until that particular output goes high and the counter is again disabled. When the switch is released, the counter will remain latched because of the 10k pull up resistor.

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EA Quiz master	$3.70
EA Variable wiper delay	$1.10
EA Playmate stereo Amp	$4.50

ALL FRONT PANELS AVAILABLE FROM DAY OF RELEASE OF MAGAZINES. WHEN ORDERING FRONT PANELS, SPECIFY COLOUR OF LETTERING FIRST, THEN COLOUR OF BACKGROUND.

CRYSTALS

FREQ (MHz)	HOLDER	PRICE
1.00	HC33	$12.50
2.00	HC33	$10.90
3.00	HC18	$7.90
4.00	HC18	$4.90
5.00	HC18	$4.90
6.00	HC18	$4.90
8.00	HC18	$4.90
10.00	HC18	$4.90
11.00	HC18	$4.90
12.00	HC18	$4.90
15.00	HC18	$4.90
16.00	HC18	$4.90
18.00	HC18	$4.90
20.00	HC18	$5.50
24.00	HC18	$5.50
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Full list of Crystals and prices available on application.

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4116 RAMS	$10.00
2114 RAMS	5.50
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BD139 10 up	2.50
BD140 10 up	2.50
SC141D 10 up	11.00
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BC547 10 up	1.00
BC548	0.15 ea.
BC549	0.19 ea
MJ802	3.60
6.800/50V CAPS (LUG)	4.50
5.600/40V CAPS (PCB)	1.90

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- ETI 470 PS kit of parts ... 19.50 (includes relay, not transformer)
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- ETI 471 pre-amp 45.50
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- ETI 585T ultra sonic TX ... 8.95
- EA 79 SF9 sound flash trigger 15.00
- All parts available for DREAM computer project.
- P.C.B.'s (all quality fibreglass boards)
  - ETI 574 disco strobe 2.80
  - ETI 549A metal detector .. 2.75
  - DREAM circuit board 10.90

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5in Minifloppy Drive
$399.00 Tax Inc
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KIT FORM $239.00
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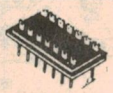
DIP PLUGS



Ideal for use with flat ribbon cable or to mount components on
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- RI 820 8V @ 20A 15V @ 1A
  15V @ 3A $35.50

20 TURN CERMET TRIM POT

SPECTROL 43P ACTUAL SIZE

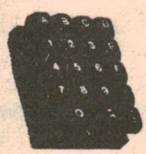
STOCK RESISTANCE VALUES
10R, 20R, 50R, 100R, 200R, 500R, 1K, 2K, 5K, 10K, 20K, 50K, 100K, 200K, 500K, 1M, 2M.

1—9	$1.30
10—99	1.20
100	1.10

Values may be mixed.

Hexadecimal Keypad

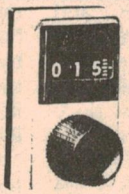
$23.50/each



19-key pad includes 1-10 keys ABCDEF and 2 optional keys and a shift key.

Ideal for dream project

MULTIDIALS



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Model 16 9" dia	$12.50
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110V **$26.50**
240V **$24.50**
Sprite fan 3⅛" square
110V $26.50
240V $24.50
Range of larger fans available. Send for details.

cermet single TURN TRIM POT

Spectrol model 63P ACTUAL SIZE

STOCK VALUES
10R, 20R, 50R, 100R, 200R, 500R, 1K, 2K, 5K, 10K, 20K, 50K, 200K, 500K, 1M, 2M.

1—9	$1.00
10—99	0.90
100	0.80

Values may be mixed.

P.C. EDGE CONNECTORS

S100 gold plated wire wrap	**$6.50**
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43/86 gold plated wire wrap	**$7.40**

DREAM

ELECTRONIC AUSTRALIA MICROCOMPUTER PROJECT

Kit for main board (including programme 2708) $115.00
Also available re-designed 6802 PCB $11.90

PCB (fibre glass) only	$10.90
2708 programmed	$15.50
Key Pad 19 keys	$22.50
Kit (less key pad)	$94.00
PCB for power supply	$3.50

10 TURN POTENTIOMETERS

Stock resistance values

50R, 100R, 200R,
500R, 1K, 2K, 5K,
10K, 20K, 50K,
100k.

Spectrol model 534 ¼" shaft.
Price 1—9 $6.50
10 + values may be mixed $5.95

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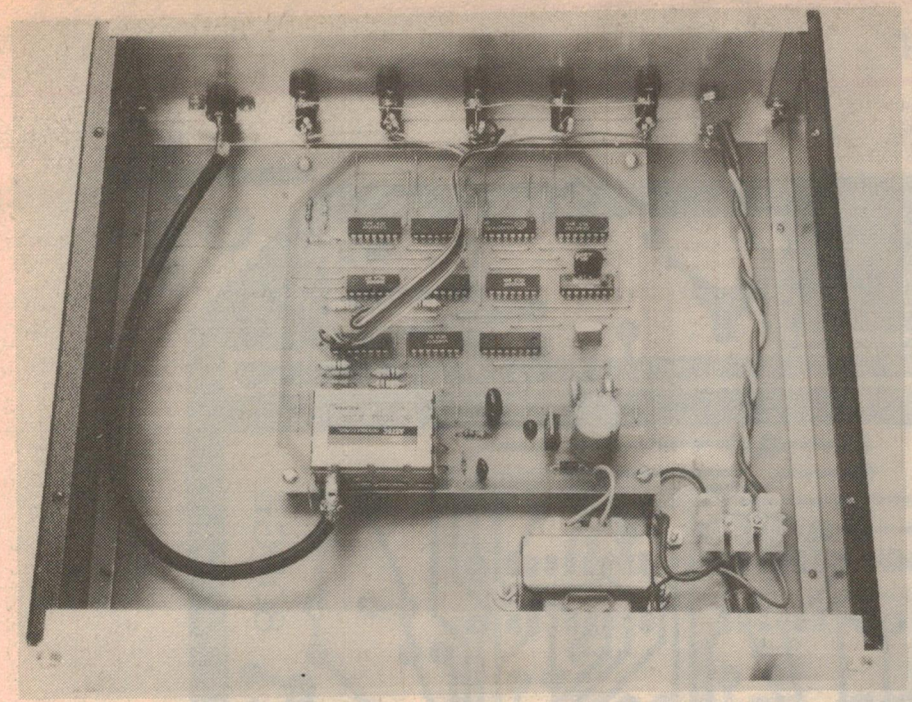
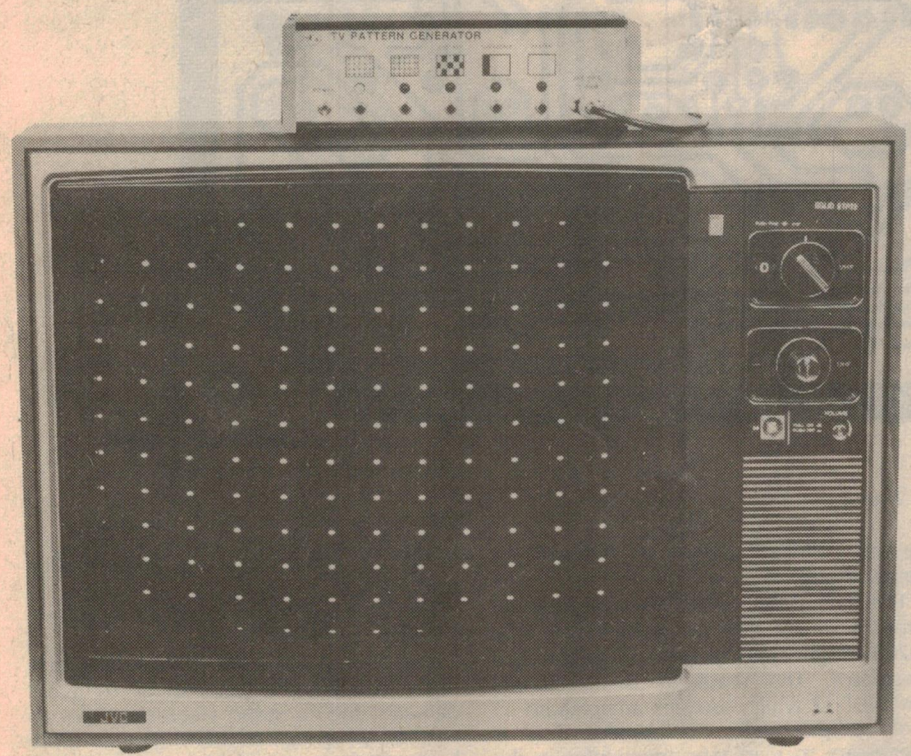


The PC board accommodates all but a handful of components. Don't forget the 2.2k resistors between the switches and LEDs and keep mains wiring neat and tidy.



The dot pattern is particularly useful for static convergence adjustments.

PARTS LIST

1 Horwood Instrument Case, 254 × 76 ×228mm (W × H × D)
1 Printed circuit board, 80PG6, 135 × 135mm
1 12.6V mains transformer; A&R2851, DSE 2851, Ferguson 6474
1 Scotchcal front panel
1 SPDT miniature toggle switch
1 4MHz crystal
1 UM1082 TV modulator
5 miniature momentary contact pushbutton switches
1 insulated line socket (Belling Lee)
2 line plugs (Belling Lee)
1 metre of 75 ohm coax cable
4 brass or plastic standoffs
1 mains cord and plug
1 mains cord clamp; grommet
1 3 way insulated terminal block
1 RCA plug
5 bezels to suit LEDs
4 rubber feet

SEMICONDUCTORS
1 4009 hex inverting buffer
1 4040B 14 stage ripple carry binary counter
1 4023B triple 3 input NAND gate
1 4520B dual synchronous up counter
2 4001B quad 2 input NOR gates
2 4011B quad 2 input NAND gates
1 4030B quad exclusive OR gate
1 4016B quad bilateral switch
1 4017B decade counter with decoded outputs
1 LM340T-5 three terminal regulator
1 1N4001 rectifier diode
1 BZX79 C6V8 zener diode
5 large red LEDs

CAPACITORS
1 470uF/25VW PC electrolytic
1 10uF/16VW tantalum electrolytic
2 0.1uF greencap (metallised polyester)
1 0.01uF greencap
1 100pF ceramic
2 22pF polystyrene

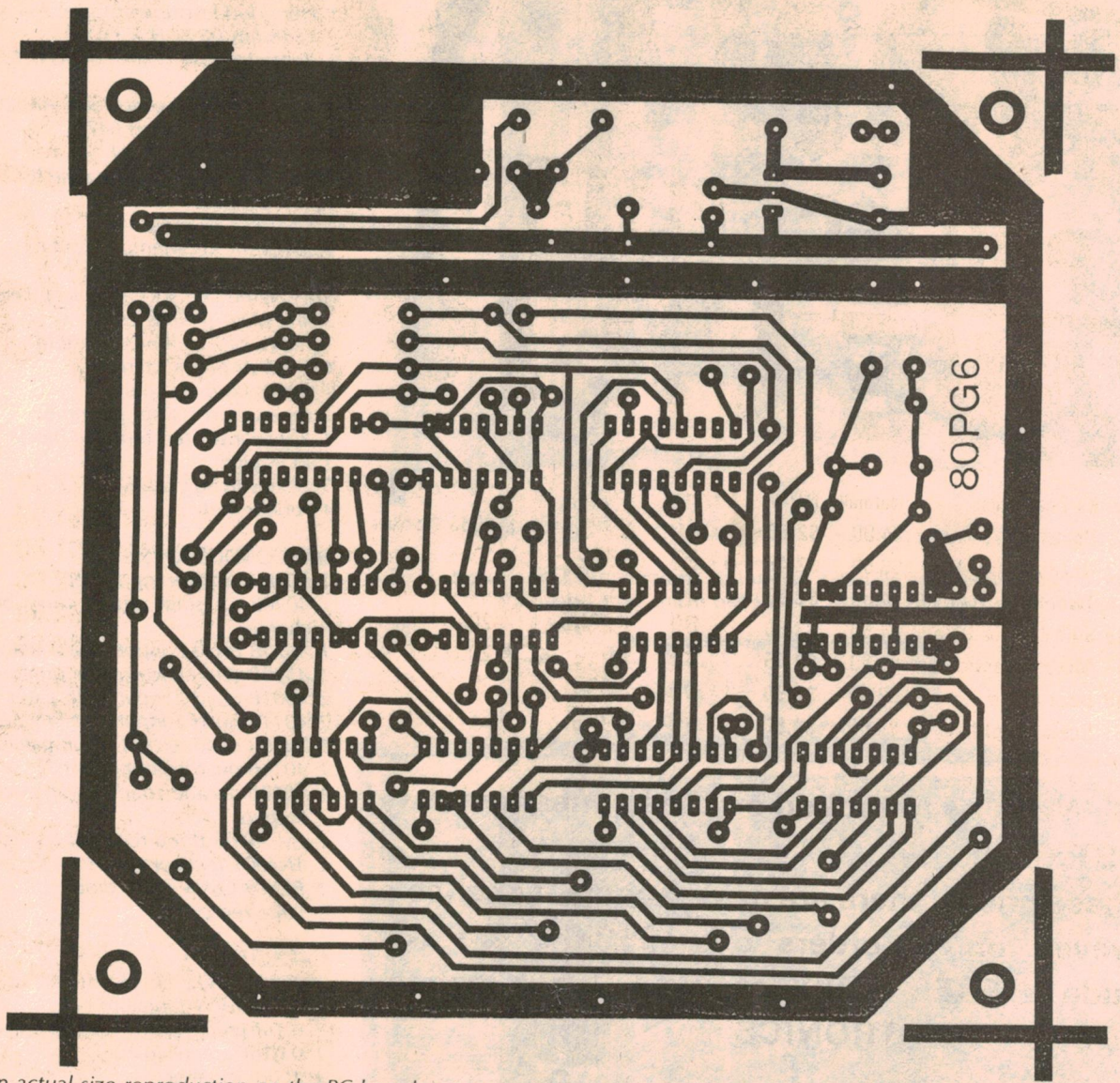
RESISTORS (all ¼ watt 5%):
1 × 10M, 8 × 10k, 1 × 6.8k, 2 × 4.7k, 5 × 2.2k, 2 × 470 ohm

NOTE: All the CMOS ICs which are listed suffixed with a "B" are "B" series buffered devices and they must be used to ensure correct performance.

Depending on which pattern was selected previously one of the corresponding outputs of IC11 will be high. These outputs are used to switch in the various patterns. The first three patterns, ie the crosshatch, dot and checkerboard patterns are selected by the three 4016 CMOS bilateral switches IC10 a, b, d. If the dot pattern, for example, were selected pin 1 on IC11 would be high and IC10b will be turned on while the other two will remain off.

If neither of the first three patterns is selected none of the three switches will be on and the signal input to IC5b will be pulled either high or low via the 10k resistor connected to the grey scale output of IC11. Hence if grey scale is selected the signal will be high but if the white raster is selected, the signal will be low. This video signal then passes to IC5b which is the video blanker. On the other input, pin 5 is connected to the combined blanking signal from IC8c so that the video cannot interfere with the sync pulses.

The video output from IC5b then passes to a simple resistive divider along with the combined sync pulses from IC6d. The values of the 10k, 6.8k and 470 ohm resistors were selected to give the correct voltage levels for the sync, blanking level and peak white of the video. Additionally, if the grey scale pattern is selected the video from IC5b will be black while IC10c is turned on, allowing the voltage step waveform from the D-to-A ladder to pass



Here is an actual size reproduction on the PC board pattern.

through to the resistive divider.

The final composite video waveform (for the grey scale) at this point can be seen in an accompanying photograph. This signal is fed to a UM1082 modulator which is a commercially built unit aligned to Australian TV channel 0. This unit has a 75 ohm output suitable for direct connection to the antenna input of a colour TV. Power for the modulator is fed from a simple regulated supply comprised of a 470 ohm resistor, .01uF capacitor and a BZX79 C6V8 zener diode.

Power for the whole unit is obtained from a simple half wave rectifier circuit, 470uF filter capacitor and a three terminal regulator. The regulator is a National LM340T-12 which supplies an accurate 12 volt output with low ripple. This is necessary to eliminate any ripples in the patterns and ensure an accurate grey scale. The 10uF capacitor and 0.1uF capacitors ensure high frequency stability for the regulator and decouple the supply lines.

That completes the circuit description.

Construction is quite straightforward. Most of the components mount on a printed circuit board coded 80PG6 and measuring 135 × 135mm. There are very few components apart from the ICs but there are a lot of links, about 45 in fact. We have used links rather than go to a double sided board because of the greatly reduced cost; we think the savings are well worth the additional effort in assembling the project.

Mount all the links and other small components first.

Next mount the CMOS ICs taking care not to handle the pins, so as to avoid damage due to static electricity. Use an earthed soldering iron and solder the supply pins first (pins 7 and 14 or pins 8 and 16) to enable the input protection network of the ICs. With the remaining components soldered to the PCB, the various mounting holes on the chassis and front panel can be drilled.

We housed our pattern generator in a Horwood case measuring 228 × 76 × 254mm (D × H × W). The box is completely constructed of metal, which is essential for proper shielding. The top, bottom and sides of the box are black marviplated for an attractive appearance.

Drill centres for the front panel switches and LEDs can be obtained by using the ac-

We estimate that the current cost of parts for this project is about

$50

including sales tax.

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K-2062	AM Tuner	$6.50	$4.50	$2.00	30%
K-2063	Bongos	$5.00	$3.95	$1.05	21%
K-2065	Electronic Siren	$5.50	$4.50	$1.00	18%
K-2066	Temperature Alarm	$4.90	$2.90	$2.00	40%
K-2067	Moisture Meter	$4.90	$2.90	$2.00	40%
K-2068	LED Dice	$5.90	$5.00	$0.90	15%
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K-2511	Battery Saver	$3.90	$1.90	$2.00	51%

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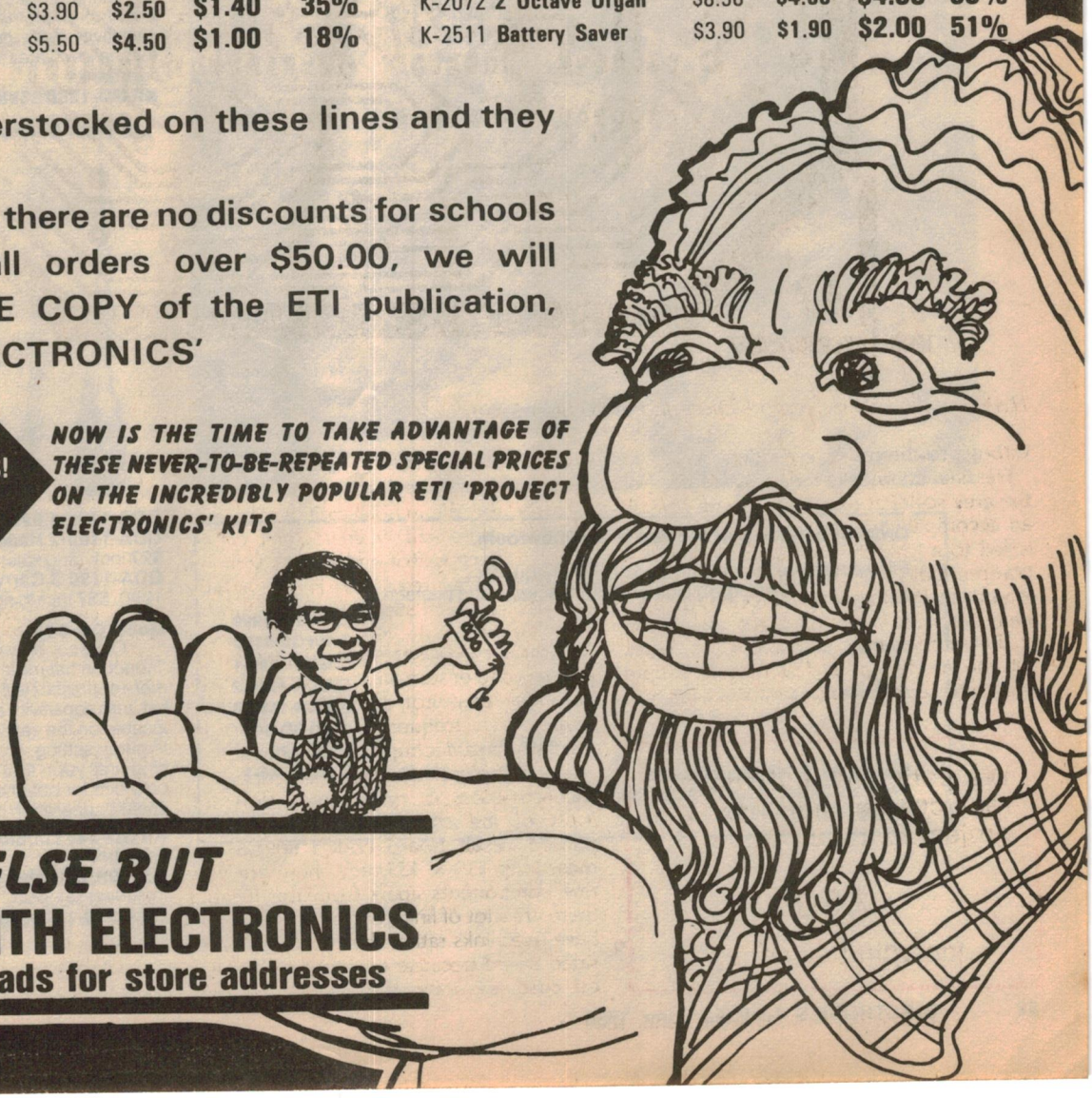

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- Real operating convenience with up-front controls and contoured pistol grips.
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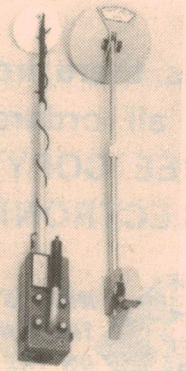
Kit GD-1290 $398.00 including sales tax.

GD-1190 GD-348



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Has the same fine features and construction as the GD-1290 above but no ground balance mode.

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Rechargeable Nickel-Cadmium Battery Pack. For GD-1190 or GD-1290. Lets you recharge the GD-1190 or GD-1290 at home from an AC outlet or in the field from the cigarette lighter of your car.

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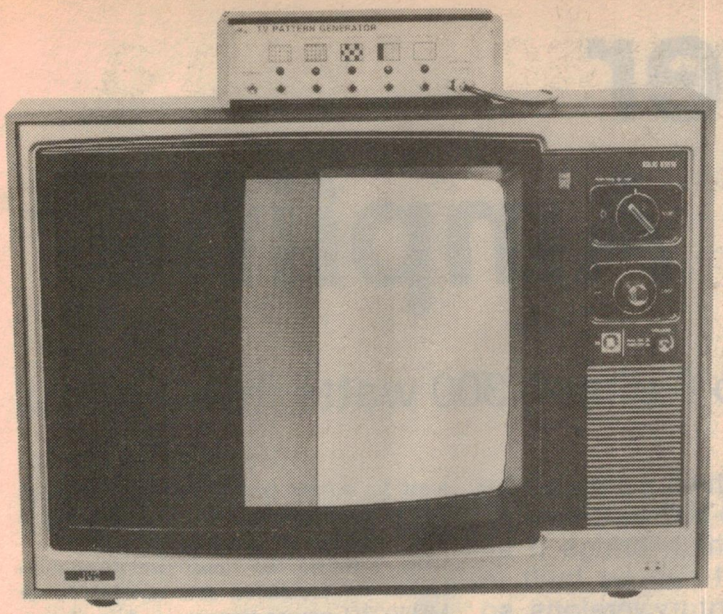
- ☐ **GD-396**
- ☐ **GDA-348-1**

WF695/80



Seven vertical bars grading from black to peak white make up the grey scale, although this is not particularly well brought out here due to photographic and printing limitations. The grey scale pattern is used to check picture contrast and grey scale tracking.

tual size front panel artwork shown elsewhere in this article. Scotchcal front panels can also be produced using the artwork or a finished front panel can be obtained from Radio Despatch Service, 869 George St, Sydney, or Rod Irving Electronics, PO Box 135, Northcote, Vic 3070.

Mount the board and the various LEDs and switches and complete the wiring using the wiring diagram and the internal photograph of the unit as a guide. Use rainbow cable to connect up the switches, routing the cable along the side of the board.

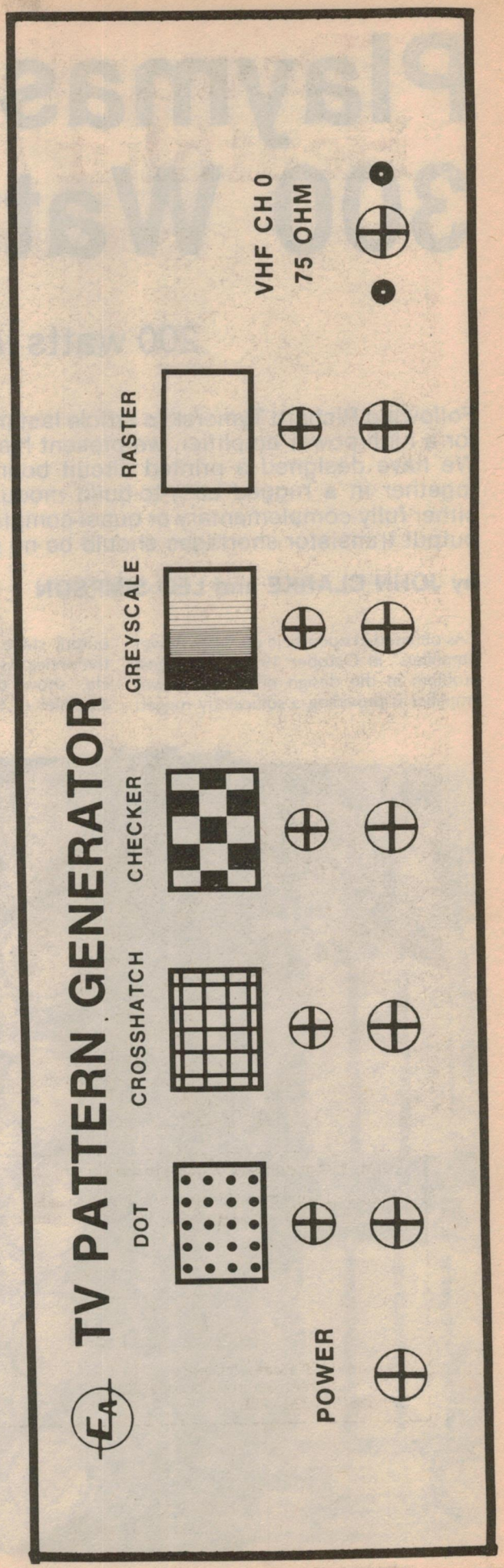
Note that the connections to the LEDs are made via 2.2k resistors soldered between the switches and the anode leads of the LEDs. The LEDs are mounted rigidly using plastic bezels.

The connection to the output of the modulator is made via a short length of 75 ohm coax cable with an RCA plug at one end. To ensure a good connection we suggest that you additionally solder a short piece of wire from the lid of the modulator to the outer section of the plug. The other end of the cable connects to an insulated Belling Lee output socket. The reason for this is that the generator must remain floating with respect to mains earth otherwise some sets may experience slight interference to the picture.

To connect the pattern generator to a TV set you must use say a metre length of 75 ohm colour TV cable terminated at both ends with a Belling Lee plug. If the TV is an old B/W set without provision for a line input socket then you can use a 75 ohm to 300 ohm balun to make a connection to the 300 ohm antenna inputs. Such baluns are readily available and are used with TV games etc. A suitable unit is available from Dick Smith Electronics.

You should now be in a position to turn the generator on. But first make a check of the PCB and your wiring and ensure that the orientation of the ICs, diodes and electrolytic capacitors is correct. With that done, plug in the pattern generator to the TV and tune the set to channel 0. The pattern selected should now appear on the screen – it is as simple as that. For best rendition of each pattern, it may be necessary to adjust the brightness and contrast controls of the set.

For those who are interested, a more comprehensive discussion of purity, convergence and other adjustments can be found in most books on colour TV servicing such as "PAL Colour TV for Servicemen" by W. C. Cook, published by Wren Publishing Ltd, Melbourne, 1974 or "PAL Receiver Servicing" by D. J. Seal, published by Thorn Radio Valves and Tubes Ltd, in association with W. Foulsham & Co Ltd, London, 1971.



Playmaster 300 Watt Amplifier

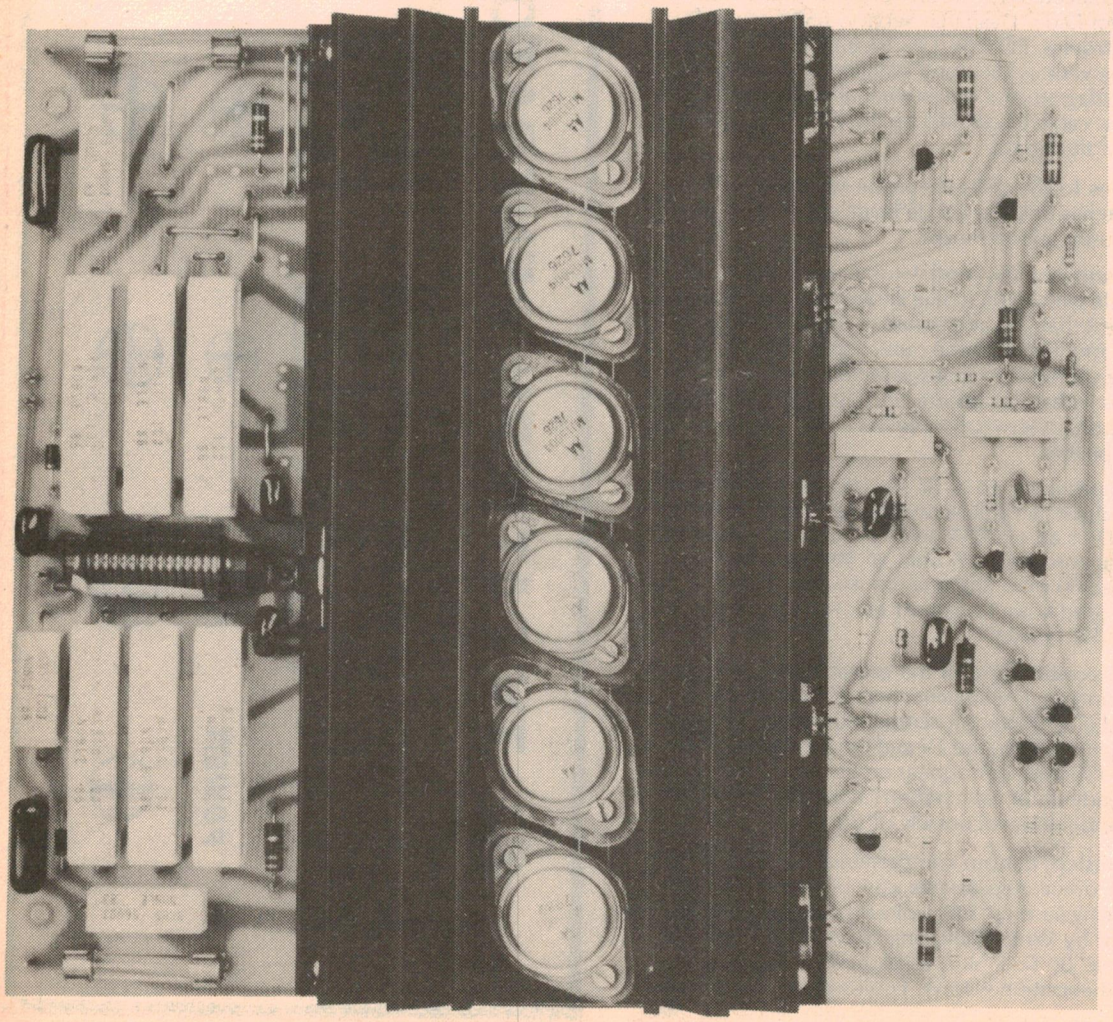
200 watts into 8 ohms, 300 watts into 4 ohms

Following Richard Tymerski's article last month on a philosophy for a high power amplifier, we present his 200-300 watt design. We have designed a printed circuit board which brings it all together in a rugged easy-to-build module. It can be built in either fully-complementary or quasi-complementary versions, so output transistor shortages should be no problem at all.

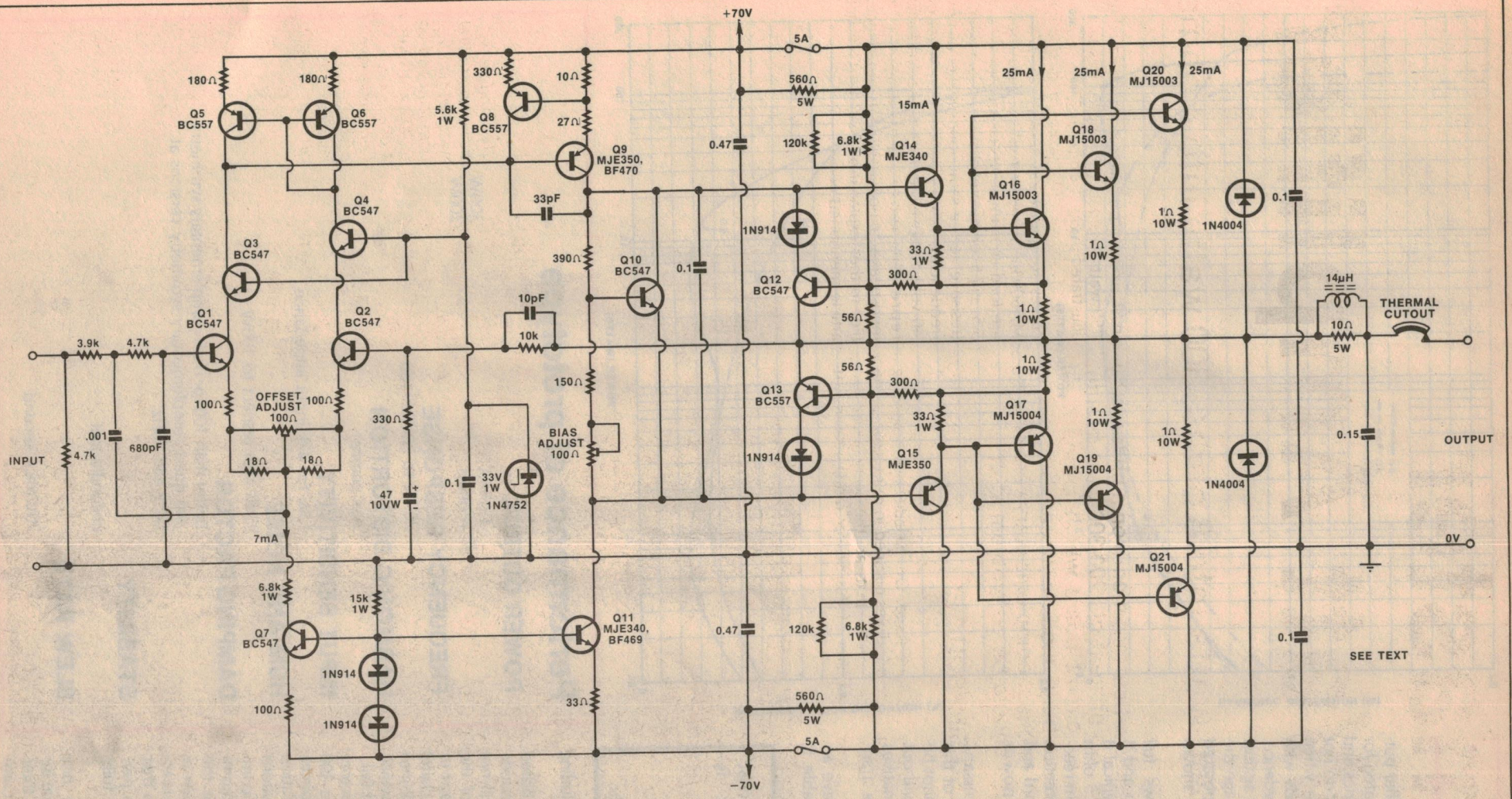
by JOHN CLARKE and LEO SIMPSON

As outlined in our article on "High Power Amplifiers" in October 1979, the biggest problem in the design of a high power amplifier is providing a sufficiently rugged output stage. Our calculations, following the principles outlined in our October article, show that at the very least, an amplifier of this power rating requires at least six output transistors, each rated at 150 watts dissipation or more. This fact is illustrated in Fig. 1 on page 57.

Fig. 1 shows the maximum dissipation curves for paralleled sets of 2N3773 or MJ15003/4 power transistors. Also shown are load lines for a typical loudspeaker at 5.5 ±j5.5 ohms (reactive) and 5.5 ohms (resistive, ie the same loudspeaker at low frequencies) when operated at a level of 40 volts RMS. Note that these loadlines represent those applicable to a loudspeaker of nominal 8 ohm impedance. (For further explanation, see our October article mentioned above).



This module will deliver up to 200 watts into an 8 ohm load and up to 300 watts into a 4 ohm load. Comprehensive protection is included. The circuit is at right.


+70V
5A
180Ω
180Ω
330Ω
10Ω
Q5 BC557
Q6 BC557
Q8 BC557
5.6k 1W
27Ω
Q9 MJE350, BF470
33pF
560Ω 5W
120k
6.8k 1W
Q14 MJE340
15mA
25mA
25mA
Q20 MJ15003
25mA
Q18 MJ15003
Q16 MJ15003
0.47
1N914
Q4 BC547
Q3 BC547
390Ω
Q10 BC547
0.1
33Ω 1W
300Ω
1Ω 10W
1N4004
0.1
14μH
THERMAL CUTOUT
Q12 BC547
56Ω
10pF
10k
Q1 BC547
Q2 BC547
3.9k
4.7k
150Ω
10Ω 5W
INPUT
4.7k
.001
680pF
100Ω
OFFSET ADJUST 100Ω
100Ω
330Ω
BIAS ADJUST 100Ω
18Ω
18Ω
47 10VW
0.1
33V 1W
1N4752
Q13 BC557
Q17 MJ15004
Q15 MJE350
Q19 MJ15004
1N914
0.15
OUTPUT
7mA
0V
Q21 MJ15004
6.8k 1W
15k 1W
Q7 BC547
Q11 MJE340, BF469
1N914
1N914
100Ω
33Ω
SEE TEXT
560Ω 5W
5A
−70V
JONES JT307
FERGUSON PF4363
47V
47V
15V
15V
MDA2504
4000 75VW
10k 1W
+70V
0V
−70V
A
240V
N
E
CHASSIS
SUGGESTED POWER SUPPLY
B
E
C
VIEWED FROM BELOW
E
B
C
E
C
B
PLAYMASTER 300
1/MA/-

While Fig. 1 shows that our amplifier output stage design is conservatively rated for nominal 8 ohm loads, (ie the loadlines and transistor power dissipation curves do not intersect), it is not so comfortable when operated into nominal 4 ohm loads with the usual range of reactive impedance. Therefore, to protect the amplifier against load conditions which would damage the output transistors, we have incorporated load line protection, which is also shown on Fig. 1.

This load line protection allows full power to be delivered into 4 ohm and 8 ohm resistive loads and also into typical 8 ohm reactive loads (eg the 5.5 ±j5.5 ohm load shown.) However, typical 4 ohm reactive loads are likely to cause the protection circuitry to operate when driven hard and thus reduce the maximum power delivered.

This compromise is absolutely necessary. While a six transistor output stage of this sort may appear very rugged, it cannot be allowed to drive 4 ohm loads without protection circuitry. The only alternatives are unreliable operation or more transistors in the output stage.

With this design approach, we have an amplifier which is just about unburstable. It will withstand any load condition including short circuits (for short durations).

Another very important criterion satisfied by this amplifier is stability. It is unconditionally stable. That means that it will not oscillate supersonically, regardless of the load connected to it. Many high power amplifier designs cannot make that claim! As a result, they sometimes do break into oscillation at supersonic frequencies which quickly causes them to overheat and fail.

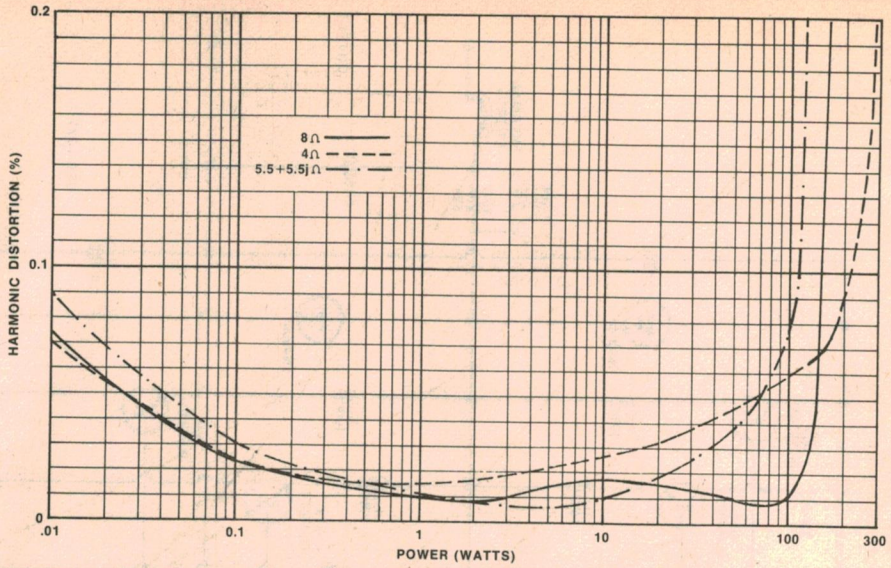
Naturally, as indicated in the introductory article last month, the new Playmaster 300 has high performance in all other respects, including low transient intermodulation distortion. The performance specifications for the prototypes (quasi and fully complementary) are summarised in an accompanying table and graphs. Note that the curves for harmonic distortion also show the performance of the amplifier into reactive loads (5.5 ±j5.5 ohms). Note also that there is no appreciable difference in performance between the quasi and fully complementary versions.

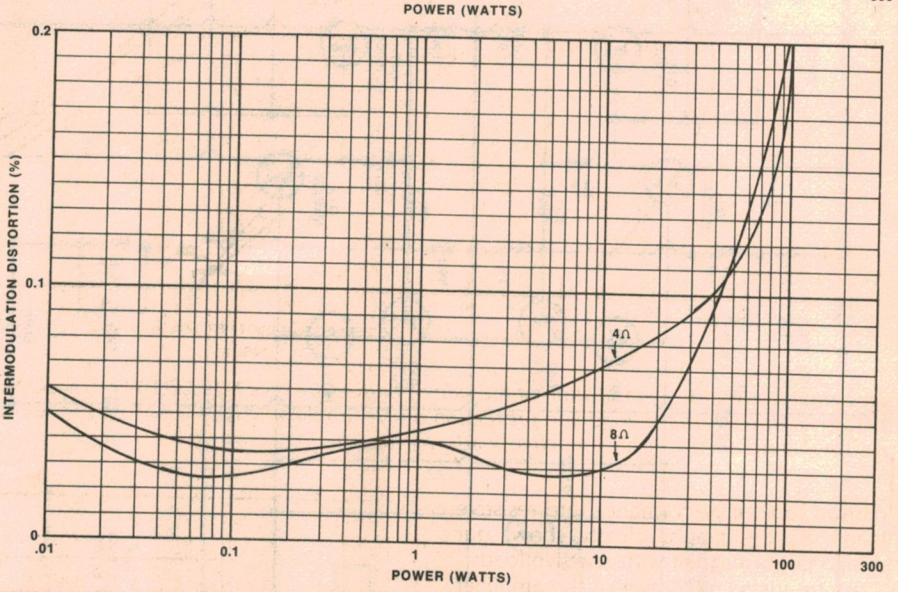
Most amplifier manufacturers do not bother to quote distortion performance into real-life reactive loads because their designs often show up badly in com-

We estimate that the current cost of parts for this project is approximately

$73

for the amplifier module alone.





Performance of prototype

POWER OUTPUT

4 ohms	300W
8 ohms	200W

FREQUENCY RESPONSE
20 Hz to 20kHz -1dB

HARMONIC DISTORTION
see graphs

INPUT SENSITIVITY
1.5V for 47k input impedance

HUM AND NOISE
95dB with respect to 100W

DAMPING FACTOR
better than 100 for both complementary symmetry and quasi complementary symmetry versions at 1kHz and 30Hz.

STABILITY
unconditional

SLEW RATE
70V/microsecond

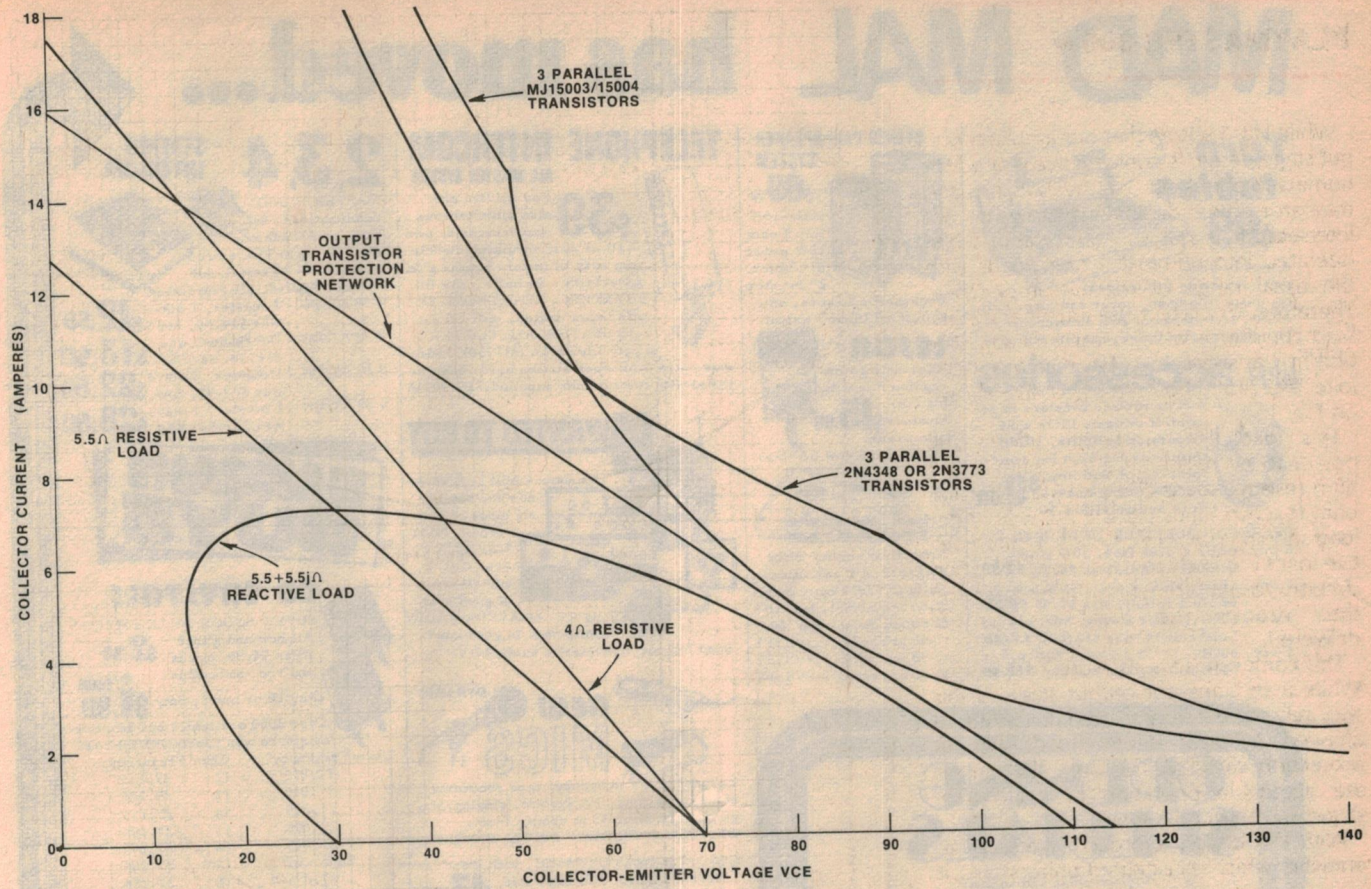


FIG. 1

This graph shows the juxtaposition of the safe operating areas of MJ15003/4 (× 3) and 2N3773 (× 3) parallel combinations of output transistors together with the load line protection of the amplifier. Also shown are the notional load lines for a 4 ohm load, and 5.5 ohms resistive and 5.5 ±j5.5 ohms reactive loads.

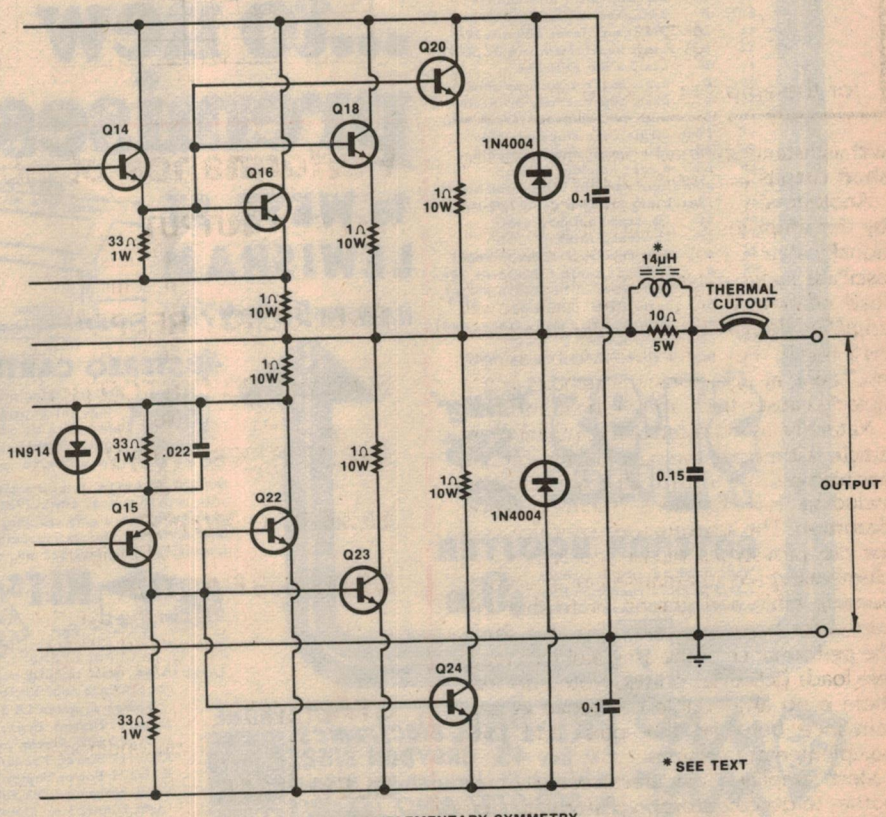
parison to their performance into resistive loads. As the graphs clearly show, our design performs well with reactive loads.

The frequency response of the amplifier is deliberately limited to -1dB down at 20kHz by the second-order low pass filter at the input stage. This is one of the measures to prevent transient intermodulation distortion. By any standard, the new Playmaster is very quiet. That figure of -95dB with respect to 100 watts into 8 ohms is equivalent to 0.5 millivolts RMS of residual noise at the output. To put it another way, if you put your ear right up to a typical loudspeaker connected to this power amplifier (with no signal connected at the input!) there is barely a whisper. . . .

All the amplifier circuitry, excluding the power supply, is accommodated on a large PCB measuring 218mm × 200mm, coded 80pa6. This also accommodates the large heatsink which is 200mm long and 105mm wide. This heatsink is adequate for typical program material peaking at full power but if the amplifier is intended for stage use, fan cooling will probably be required.

As well as having all six power transistors mounted on it, the heatsink also accommodates the four driver stage transistors, the Vbe multiplier transistor and a thermal cutout. (Unfortunately, at the time of writing, the thermal cutout is unavailable.)

Ten-turn preset pots are provided for



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3 way, 600Hz, 3KHz x'over, 50W power, 12dB rolloff, was $12.50 **$8.50**
3 way, 600Hz, 3.5KHz x'over 80W power 12dB rolloff, new model **$12.90**

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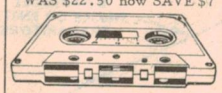

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6	Sold Out!	17	27.205
7	27.095	18	27.225
8	27.105	Marine	27.880
9	27.115	Marine	27.890
10	27.125	Marine	27.900
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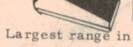

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7	15	alligator clips, asst. sizes
8	2	PL-259 UHF plugs & sockets
9	4	std 3AG panel fuseholders
10	8	3AG asst. types fuseholders
11	20	3AG asst. fuses 250mA-30A
12	8	asst. bezels/lamps 6,12,240V
13	10	asst. slide switches
14	8	asst. tog/rot/push switches
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16	8	mini vol. controls (trans rad)
17	10m	single core shielded cable
18	8m	twin fig. 8 shielded cable
19	6m	4 core shielded cable
20	20m	light speaker cable, col-coded
21	12m	heavy speaker cable col-coded
22	5m	10 strand rainbow cable
23	3m	16 strand rainbow cable
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25	8	EHT car radio suppressor res.
26	5	asst. cermet multiturn preset pots
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28	5	asst. tuning gangs, trans. rad.
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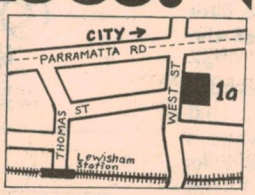

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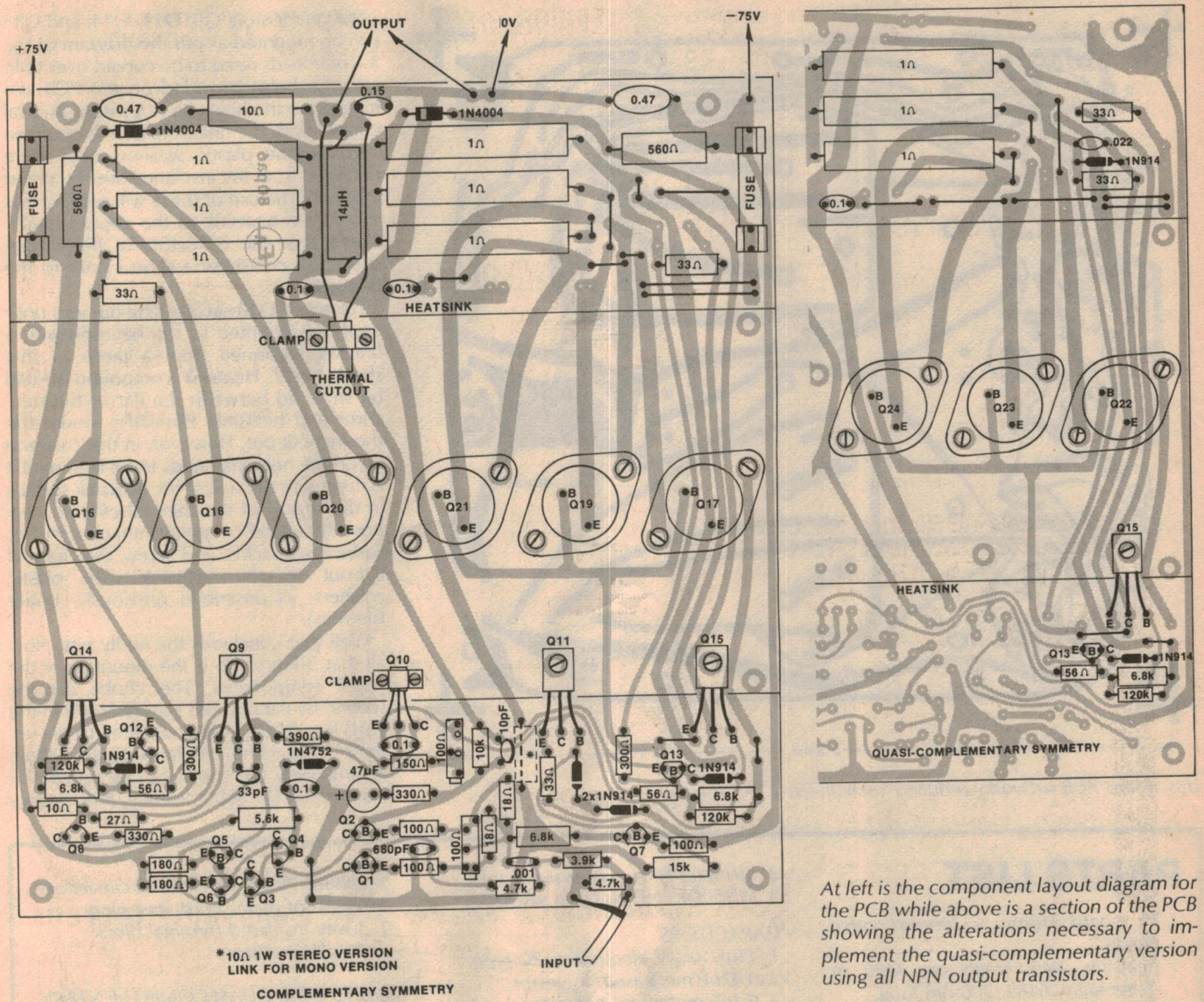


At left is the component layout diagram for the PCB while above is a section of the PCB showing the alterations necessary to implement the quasi-complementary version using all NPN output transistors.

precise and easy adjustment of quiescent current and output offset voltage. If unavailable, conventional trimpots can be substituted. Onboard fuse protection of the amplifier is also provided, as well as fixed resistors for monitoring the quiescent current.

A casual glance at the PC pattern overlay will reveal many links. These were not provided to make life more difficult, but to allow two versions of the amplifier possible; namely the complementary symmetry and quasi complementary symmetry configurations mentioned above. The complementary symmetry version output stage has NPN/PNP complementary pairs, while the quasi has all NPN transistors.

Construction of the amplifier module should begin with drilling the holes for the components to suit the diameter of the component leads. The links are 16 gauge tinned copper wire and consequently require an appropriate hole size.

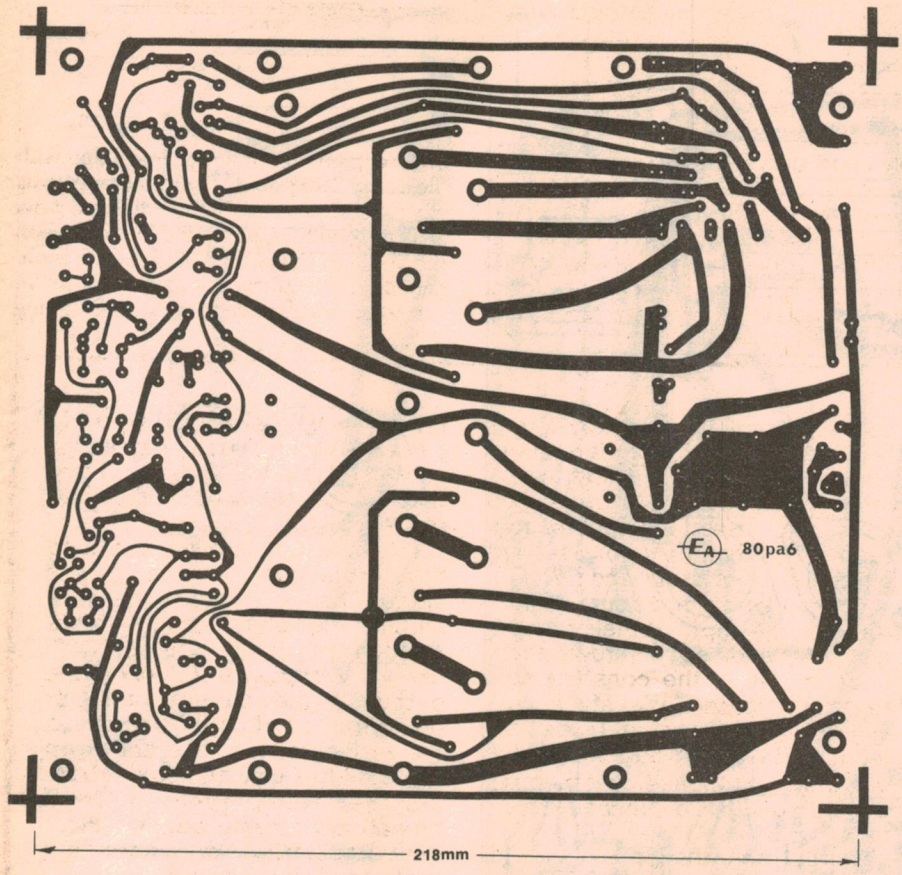
The heatsink can now be clamped into position and the four mounting holes for each corner of the heatsink drilled from the PCB side using the marked copper holes as a guide. Temporarily bolt the heatsink into position making sure the heatsink is centred above the TO-3 mounting holes.

The remaining holes in the heatsink can now be drilled. The holes for the bracket mounting of Q10 and the thermal cut-out are also marked with the copper pattern and should be drilled now as well. After drilling, remove the heatsink and deburr all the holes, particularly the transistor holes, since even a small whisker of metal can pierce the mica washers.

With all drilling operations completed, the links may be inserted. Those in the output stage use 16-gauge tinned copper wire while those links in the input stages can use thinner wire.

Now the power transistors and heatsink can be assembled. Follow the drawing of Fig. 2 to assemble the insulating components. The bush surrounding the bolt is a standard mounting bush with the integral washer removed with a razor blade. These washers can be used so do not throw them away. With a smear of heatsink compound on each surface of the mica washer, transistor and heatsink, tighten up the screws and solder the nuts to the copper. It is a good idea not to solder the base and emitter leads yet, just in case the insulation is faulty and the transistor has to be removed.

Check the insulation of each transistor from the collector (case) to heatsink with an ohm-meter as you finish mounting each one. If there is a short circuit, repair the fault immediately as it is difficult to find the fault when they are all assembled. Retighten down the transistors after the heatsink compound has time to spread under pressure and recheck the insulation.



This is the PCB artwork, reduced to half size.

Now transistors Q9, Q11, Q14, and Q15 can be mounted as per the diagram of Fig. 3. Their leads need to be curved over to fit into the holes provided on the PCB and make sure the leads do not make physical contact with the heatsink. Bolt them down and use the plastic washers, that were removed from the insulating bushes, under the nuts. The use of these will prevent any short from heatsink to the copper tracks. Check that the collectors of these transistors do not show a short circuit to the heatsink.

Transistor Q10 can now be put into position and mounted to the heatsink with a bracket fashioned from a piece of thin sheet metal. Heatsink compound should be smeared between the flat of the transistor and heatsink. (Similarly, mount the thermal cut-out. However, in this case the lip on the heatsink needs to be filed until it is flush with the rest of the heatsink surface in the region of the thermal cut-out position, to enable a good surface contact. Fashion a bracket and screw the thermal cut-out to the heatsink. Use plastic washers, as described previously, under the nuts).

Well that concludes the fiddly bits. Now all that is left to do is the mounting of the other components. The choke can be wound by hand to the specifications in the parts list and the wire coils glued to the ferrite or held with heat shrink plastic tubing. Alternatively the choke can be purchased from Radio Despatch Service, 569 George

PARTS LIST

1 PC board 218mm × 200mm coded 80pa6
1 heatsink, Dick Smith cat 3426 or Thermalloy 6169, 200mm long
1 14uH choke, 19 turns of 16 gauge wire on Neosid F14 ferrite 40mm × 10mm diameter.
1 thermal cut-out, 10A, 95 degrees (if available)
4 fuse clips, Swan (McMurdo) FC1 part No 1397-01-18
2 5A 3AG fuses
6 TO-3 mica washers
4 TO-126 mica washers
12 insulating bushes
1 200mm length of 16 gauge tinned copper wire

SEMICONDUCTORS
4 1N914 silicon signal diodes
2 EM404, 1N4004 400PIV 1 amp silicon diodes
1 33V 1W zener diode, BZX61, C33, 1N4752
4 BC557 PNP transistors
7 BC547 NPN transistors
2 MJE350 PNP transistors
2 MJE340 NPN transistors
3 MJ15003 NPN power transistors
3 MJ15004 PNP power transistors

CAPACITORS
1 47uF/10VW electrolytic PC type
2 0.47uF metallised polyester
5 0.1uF metallised polyester
1 .001uF metallised polyester
1 680pF ceramic
1 33pF ceramic
1 10pF ceramic

RESISTORS
(¼w unless other specified, 5% tolerance)
2× 120k, 1 × 15k/1W, 1 × 10k, 3 × 6.8k/1W, 1 × 5.6k/1W, 2 × 4.7k, 1 × 3.9k, 2 × 560 ohm/5W, 1 × 390 ohm, 2 × 330 ohm, 2 × 300 ohms, 2 × 180 ohm, 1 × 150 ohm, 3 × 100 ohm, 2 × 56 ohm, 1 × 33 ohm, 2 x 33 ohm/1W, 1 × 27 ohm, 2 × 18 ohms, 1 × 10 ohm, 1 × 10ohm/5W, 6 × 1 ohm/10W, 2 × 100 ohm vertical trim pots or 2 ten-turn miniature ceramic trim pots.

PARTS LIST FOR POWER SUPPLY
1 Transformer, Ferguson PF 4363, Jones JT 307 or 94VAC, CT at 3A.
1 bridge rectifer MDA2504, 400 PIV, 25A.
2 4000uF/75VW electrolytic capacitors
1 length of mains cord, and plug
1 3-way insulated terminal block
2 10k/1W resistors

PARTS FOR QUASI-COMPLEMENTARY SYMMETRY VERSION

OUTPUT TRANSISTORS
6 NPN silicon power transistors, MJ15003, 2N3773 or 2N4348

EXTRAS
1 1N914 silicon signal diode
1 .022uF metallised polyester capacitor
1 33 ohm/1W resistor

MISCELLANEOUS
Aluminium for transistor and thermal cut-out brackets 4mm × 4mm approx, heatsink compound, PC stakes, nuts, bolts, washers, solder etc.

NOTE: Resistor wattage ratings and capacitor voltage are those used for our prototype. Where voltage ratings are not quoted, they should be 100V or more. Components with higher ratings may be used provided they are physically compatible.

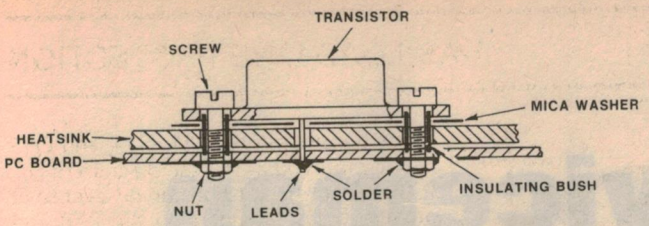


FIG. 2 : TO-3 MOUNTING METHOD

These two diagrams show the transistor mounting details.

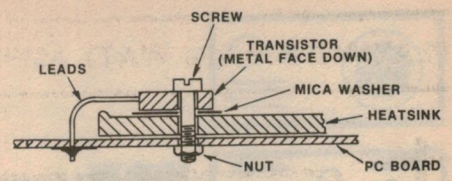


FIG. 3 : TO-126 MOUNTING METHOD

St, Sydney.

When mounting the 5W and 10W resistors, solder them with at least 1mm spacing above the PCB to allow cooling and to avoid their charing the board. Take care in orienting the polarity-conscious components such as the diodes, transistors and electrolytic capacitor.

Finally, the use of PC stakes is recommended for the external connections, allowing easy access to the terminals with a meter.

A suitable power supply is required before the amplifier offset and quiescent current adjustments can be set. This is shown on the circuit diagram but we shall discuss its construction next month. Before proceeding with the discussion of adjustments, note that the power supply voltages are **dangerous**, as a total of 140 volts DC is present. Under the right circumstances (or wrong, depending on your point of view) this high voltage power supply could deliver a **lethal** shock. In other words, it could kill you. So be very careful. Remember that the high voltage is present on the cases of the output transistors.

10k/1W resistors are connected as "bleeders" across the 4000uF electrolytic filter capacitors to dissipate the voltage when the power is removed.

The setting up procedure is rather simple. Firstly set the offset pot to about the centre position and the quiescent current (bias) pot to maximum resistance. Without the fuses present, apply power to the module and quickly check the voltage across the fuse clips (560 ohm resistors). If the voltage across each pair of fuse clips is less than say about 50V, then all is well; if the total power supply voltage is impressed across the fuse clips, then it is possible that there is a short from the output transistors to the heatsink.

If all is well, measure the voltage between the amplifier output and power supply common, and adjust this voltage with the offset trimpot until the voltage is as close to zero as your meter will read. Now adjust the voltage across the fuse clips with the bias trim pots until a 50V reading is obtained. The voltage should be similar across each of the fuse clips. This setting corresponds to a 25mA current through each output transistor.

With the fuses in position, the current can be rechecked provided a meter that can read 25mV is used. By measuring the voltage across each emitter resistor, the current can be determined. The current should be 25mA in four of the resistors and 40mA in the emitter resistors of Q16 and Q17. This extra current is from the current flow in Q14 and Q15.

Next month we shall give details of how to mount the module in a 19-inch rack mounting chassis, together with power supply, fan cooling and loudspeaker protection circuitry.

HOW IT WORKS:

While the large number of transistors in this amplifier may make the circuit seem unduly complex, it is really quite straight-forward. The circuit is basically a direct-coupled amplifier with differential input stage, class-A driver stage with constant-current load, and with output transistors and drivers working in class AB emitter-follower configuration.

Right at the input is a second-order (12dB/octave) filter comprising two resistors and two capacitors. This filter reduces the maximum slew rate of the input signal to a value which ensures freedom from TIM, as mentioned elsewhere in this article.

Q1 and Q2 make up the differential input stage, in conjunction with Q3 and Q4 operating in cascode configuration. In effect, the bases of Q3 and Q4 are referenced to +33V by the zener diode and grounded to AC. So, regarded in isolation, Q3 and Q4 can be considered as grounded-base stages which transfer the signals appearing at the emitters to their collectors.

The main virtue of the cascode configuration is that it reduces the collector voltage to Q1 and Q2 so that readily available low voltage transistors can be used. Apart from that, the cascode configuration also gives an extended frequency response to the input stage, as does the emitter degeneration due to the common resistors in the emitter circuits of Q1 and Q2.

Q5 and Q6 form a "current mirror" for the input transistors Q1 and Q2 and so improve their linearity. Q8 is the constant current "tail" for the input stage, providing a high "common mode" rejection ratio and so minimising the amplifier's response to the hum content on the balanced supply rails.

Output from the input stages is coupled to Q9, which in conjunction with its constant current load, Q11, functions as a class-A driver. Q8 protects Q9 against excessive loading which may occur when the protection circuits operate. Q10 is a "Vbe multiplier" which sets the quiescent bias for the output stages and provides thermal stability.

Eight transistors make up the complementary symmetry output stage which operates in class AB emitter follower mode. Class AB means that the amplifier works in class B mode at higher power levels while the fixed bias from Q10 provides class A operation at low signal levels. Q16 to 21 work in current-sharing mode, with large emitter resistors to make sure that they do, in fact, share the load current equally.

Q12 and Q13 provide the load line protection for the output stage. Their associated resistors monitor the voltages and currents through transistors Q16 and Q17, and act to bypass the signal to the output if the output transistor operating conditions transgress the designated load line, shown on Fig. 1. In this way, the output transistors are prevented from operating in unsafe "areas" where over-dissipation or secondary breakdown could occur.

The diodes connected in series with Q12 and Q13 prevent these transistors being reversed-biassed and bypassing the drive signal, during normal operation.

The diodes across the output stages are also part of the protection circuitry, preventing "spike" voltages developed by rapid turnoff of output transistors from causing damage.

The 560 ohm resistors across the fuses are there for convenience only, for the initial setting up procedure and also for trouble-shooting fault conditions which would otherwise blow fuses.

The Serviceman

How to suffer from a red face — even in winter!

On several occasions over the years I have stressed just how treacherous intermittent faults can be and how vitally important it is to follow up such faults until the "cure" has been proven. If ever I needed a "horrible example" to prove this point, a job I encountered a few months ago must surely qualify — it very nearly beat me.

This story was actually written in two parts and, in the interest of authenticity, I propose to present it in that form; the main story plus a sequel – the latter constituting the real core of the exercise.

It concerns a Decca model 33 hybrid TV set which already had a history of above-average service for this model. Granted, they had been routine faults until now, but there had been far more of them than was typical in one chassis. But these had been early in its history and, for the previous year or so, I had heard nothing of it.

Then the customer walked into the shop one day and complained that it had developed a new and rather irritating fault. As he described it, the picture would roll at various intervals (which was clear enough) and ". . . the picture is all bendy." (Which was not so clear.) "And," he added, "it only happens at night."

I've had worse descriptions of set behaviour, but I've had better ones too. The "all bendy" could mean almost anything, and I am always suspicious of claims that the fault only occurs at certain times. Granted, time of day does sometimes have a bearing on the problem but, usually, there is a much simpler explanation.

In this case, for example, I suspected that the set was used a good deal more at night than during the day; this was when the fault became obvious.

And while I did gently suggest this possibility about the viewing times, diplomacy dictated that I not press the point. Instead, I said I would call at the first opportunity and (hopefully) see the symptoms for myself.

Needless to say, when I did visit the home, the set showed no sign of any of the symptoms. Nevertheless, it gave me a chance to talk to the family and get a better idea of what they were trying to describe. I also made a couple of routine checks.

One was a line voltage check. The customer lived near the end of a power line and it was possible that the fault was voltage sensitive. The line voltage was normal when I measured it, but I had brought along the Variac and used it to simulate a possible night-time voltage drop. The result was negative, the set performing perfectly at quite seriously reduced line voltage.

The other check involved the PFC802 (V4) line oscillator valve, a triode/pentode type. This valve has something of a reputation for intermittent faults which can cause momentary loss of line hold and might give rise to the condition described as "bendy". So I simply replaced it.

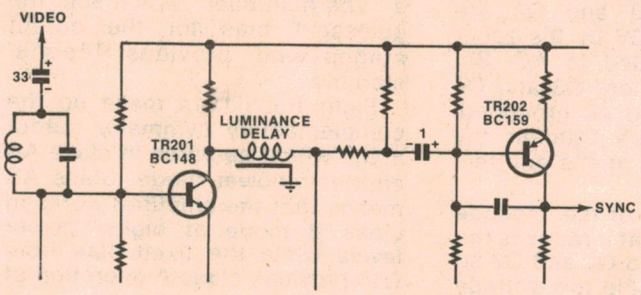
Several weeks went by and I was beginning to hope that I might have fluked a cure. But this was not to be, for the customer duly rang to say that the fault was still in evidence – making another attempt to describe how the picture was "distorted".

As before, it was hard to make sense of his description but, by careful questioning, I finally concluded that he was trying to describe what is commonly called "flag waving". This is a condition, at the top of the picture, where alternate fields are displaced horizontally. Vertical lines will split, one half remaining vertical, or bending to the right, and the other half bending to the left. In addition, both halves flicker badly.

The precise cause is difficult to nominate, but it usually involves the horizontal sync, since lines are displaced. But it also involves the 50Hz frame circuits, since displacement occurs at the beginning of every field.

This puzzled me, because I hadn't seen it happen in this model, or any other colour set for that matter. Indeed, it was some years since I had seen it in a monochrome set. In any case, there was little I could do until I could verify the description. So, by common consent, it was decided to leave things as they stood until, hopefully, the fault worsened.

That was the last I heard of the customer for over three months, and I was on the point of contacting him. In fact, he saved me the bother with a phone call, explaining that the set had behaved faultlessly until a few days ago, but that it was now playing up very badly. I promised to call first thing the next morning.



One intermittent component in this section of a Decca model 33 hybrid receiver kept the serviceman guessing for weeks. A sure way to make a slow buck!

And this time I struck oil. The set did misbehave and I derived some satisfaction from noting that my assumption was correct; it was flag-waving, plus, of course, the spasmodic rolling. I noted also that the degree of flag-waving seemed to vary with the video content.

I decided to concentrate on the rolling problem first, reasoning that it should be easier to track down and in the hope that the same fault might be responsible for the flag-waving. This set has no vertical hold control, the frame oscillator being a multivibrator designed to lock positively to the sync pulses.

I replaced the two multivibrator valves,

the PCF80 (V2) and the PL508 (V3), but this had little effect on the fault. Next I went over the minor components in the multivibrator circuit and found a few somewhat out of tolerance, which I replaced, but without much confidence.

However, the problem had vanished, at least for the time, but I was far from convinced. On the other hand, there seemed little point in taking the set in, particularly as the customer was keen to follow a favourite program for a couple of days.

I wasn't really surprised when he called again a couple of days later with the news that the set was as bad as ever, and that I had better take it in and keep it as long as was necessary.

So it was eventually set up in "intermittent corner" and I simply let it run while I attended to other jobs. Nothing happened for several days until one morning it suddenly started flag-waving. This was it, I thought, as I stoked up the CRO and prepared for battle.

The sync pulses were the obvious suspects, so I made for the sync separator. In this set, video from the detector goes through a two-stage video amplifier, then to another board on which is the luminance amplifier, a BC148 (TR148 (TR201), the luminance delay line, and a sync separator stage, a BC159 (TR202).

In fact, the BC159 is only part of the sync separator system, the other part being the pentode section of V2, the PCF80, on another board. The grid of the PCF80 provided a convenient check point, but the waveform here appeared to be normal.

I moved back to the BC159 and connected the dual trace CRO so as to monitor both the input and output waveforms of this stage. The fault had vanished by now, so I took careful note of the waveforms under normal conditions, then waited for the fault to re-appear.

It didn't take long, and when it did, I noted that, while the input waveform appeared the same, the output had changed; not grossly, but enough to be noticeable. This suggested that the BC159, or associated components, could be the cause. I made a voltage check around the transistor and could find nothing wrong, so I promptly pulled out the BC159 and replaced it.

Feeling fairly confident, I switched the set on again and waited. It came as a shock when it took only about three minutes for the set to tell me that I had achieved exactly nothing; the fault was as bad as ever. So – back to square one!

I went over the stage again and checked all the resistor values, and replaced the coupling capacitor from the previous stage. This is a 1uF electrolytic, and experience has taught me that many modern low value electrolytics are somewhat unreliable. But all to no avail.

So what now? Could it be in the luminance delay line, ahead of the sync separator? Or in the luminance amplifier? In as much as the video did not seem to be effected in any way I tended to dismiss this idea. On the other hand, I felt I should check them out, if only for something to

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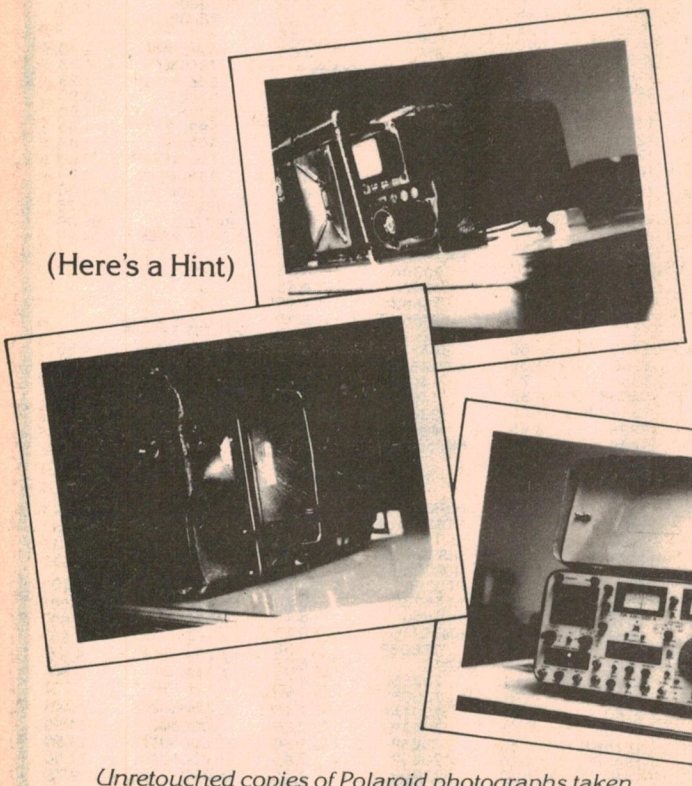
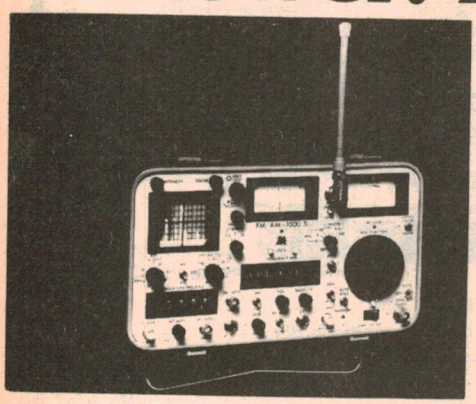


Unretouched copies of Polaroid photographs taken immediately upon arrival of case #3 at the Customer Service Department. All we did was connect power and turn it on.

*answer: ifr Service Monitors...

FM/AM-1000A and FM/AM-1000S



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do while waiting for a better idea.

So I went over the luminance amplifier stage and checked resistor values, voltages etc, but could find nothing wrong. So, more in desparation than hope, I changed the BC148 transistor.

And, believe it or not, that was it. The set behaved faultlessly from then on. I let it run in the workshop for over a week, and it didn't miss a beat in all that time. Considering how it had been behaving before, such an order of improvement could not be coincidence. And at the time of writing, the set has been in the customer's home for over three weeks and still hasn't even flickered.

As far as I'm concerned, the point has been proved.

Well, that was the story as originally set down, ready for publication. The only reason it didn't appear in print was that there were several stories ahead of it; which was just as well, or my face might have been redder than it is already.

About six weeks had gone by since I last checked with the customer when I encountered him in the street. "Oh", he said, "I was just on my way to see you. I'd like you to have another look at that set. It still plays up — though only occasionally."

That was a bit of a shaker, to put it mildly, and the "only occasionally" qualification did nothing to soften the blow. The simple fact was that I hadn't found the fault.

So, once again, the set was installed in

"Look, forget the intermittent. We're going out for dinner!"

"intermittent corner" and I waited for the symptoms to appear. It was some time before they did and, when they did, their appearance was quite brief. But there was no doubt it was the same fault and, once again, I noted that video content, particularly a very bright picture, seemed to induce the condition.

Taking up where I left off, at the BC148 (TR201) which I had replaced and which seemed to cure the fault, I tried to think what other component might be a likely suspect. The combined video signal — luminance, chrominance, and sync — is fed to this board via a test point (TP200) then to the base of the BC148 via a 33uF electrolytic (C200) and a trap circuit (L200/C201).

I connected the CRO to the base of the BC148 and monitored the sync signals during both normal and fault conditions, but could not really detect any significant difference. Which left me with little alternative than a suck-it-and-see approach.

Ahead of the BC148, the most likely components were the trap circuit and the 33uF electrolytic and, of these two, the electrolytic seemed to be the best bet, if only because these things can deteriorate. On the other hand, values as high as this are much more reliable than the smaller ones.

So the 33uF was duly changed. And, at the risk of tempting fate, I am confident that that was it. I ran it on the bench for another week without any hint of trouble and then, not without some reservation, took it back to the customer. I explained that I hoped that I had found the trouble this time but stressed that I couldn't be sure and urged them to contact me immediately if the fault appeared again, no matter how briefly.

In addition, I made regular follow-up checks myself. That was over three months ago and the owner assures me that there hasn't been even a suspicion of the fault so far. But I'm still keeping my fingers crossed.

What was wrong with the electrolytic, and why did it do what it did? And why did changing the BC148 seem to cure the fault so effectively?

There seems little doubt that the fault was due to reduced capacitance in the 33uF, though whether this was intermittent, or simply reduced to a borderline value, I have no way of knowing.

But I rather suspect the latter. What is more, I suspect that the apparent cure after changing the BC148 may not have been just coincidence. It is just possible that the gain of the original BC148 might have been at the bottom of the range, and that of the new one at the top of the range. If so, the increased level might have been sufficient to mask the fault until the capacitor deteriorated further.

In support of this is a very strong impression that, on the second occasion, the fault did occur less frequently, and for shorter periods, then when it was at its worst.

But, at best, this is only speculation; I shall never know the truth. Suffice it to say that I was really very lucky. Had the customer not trusted me sufficiently to come back, and had gone elsewhere, my reputation would have suffered.

And, by the same token, the bloke "elsewhere" would have had to start from scratch, with only a garbled account of what had been done, and go through the same tests and trials as I had. It could have been another long, costly, and frustrating exercise.

For circuit design, debugging & servicing

Handy, low-cost R & C substitution boxes

Whether you are involved in servicing, circuit design at the professional or hobby level, or in testing electronic equipment, a set of resistance and capacitance substitution boxes is very useful. Put any or all of these four substitution boxes together and you may wonder how you ever managed without them.

by GERALD COHN

Resistor and capacitor substitution boxes are items that are often highly desirable, both in the workshop or in the field. Yet many of us still do without them, for the simple reason that the effort and time required to put one together just seems too high a price to pay for the convenience. But how often does one find that a perfectly good capacitor or resistor has to be thrown away because the pigtails have broken off in service through continued bending and flexing?

No doubt the reader can think of many instances when a substitution box would not only have saved him an otherwise good component, but also time and effort. Circuit design, for example, is one area where that last stage of debugging can be made so much simpler by the use of substitution boxes. To be able to select the exact value for a particular component by the mere flicking of a number of switches and all without unwanted hand capacitance effects is a decided advantage.

This article describes four simple, low-cost substitution boxes which have been designed especially for use in such instances. Included are three capacitor substitution boxes, and a decade resistance substitution box. We will consider the decade resistance box first.

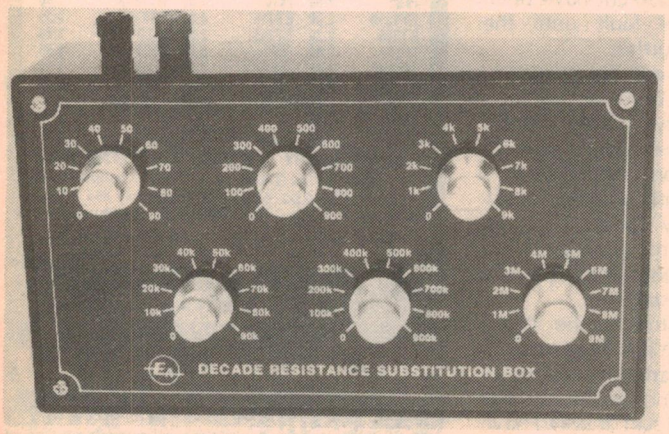
RESISTANCE BOX

The resistance substitution box covers six decades of resistance values from 10 ohms to 10 megohms. Since there is more than one decade, it is called a "decade box". This name is derived from the arrangement used to select and switch in the desired component value.

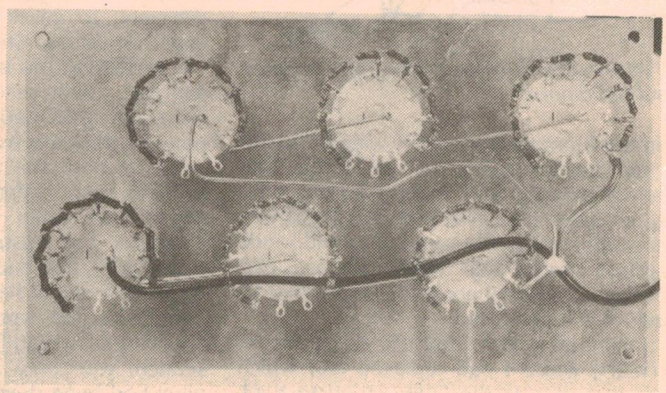
As the circuit shows, each decade consists of a 10-position rotary switch, to which are connected nine identical resistors. Six of these switches are connected in series, the resistors on each having a value 10 times greater than those on the preceding switch. Any value between 10 ohms and 10 megohms, in increments of 10 ohms, may be selected.

When we designed this unit, we elected to use 10 ohm increments instead of the 1 ohm increments often used on commercial substitution boxes. The reason for this is that switch contact resistance can considerably upset the accuracy of very low ohms settings. Commercial units get round this problem by employing high quality switches which, of necessity, are rather expensive.

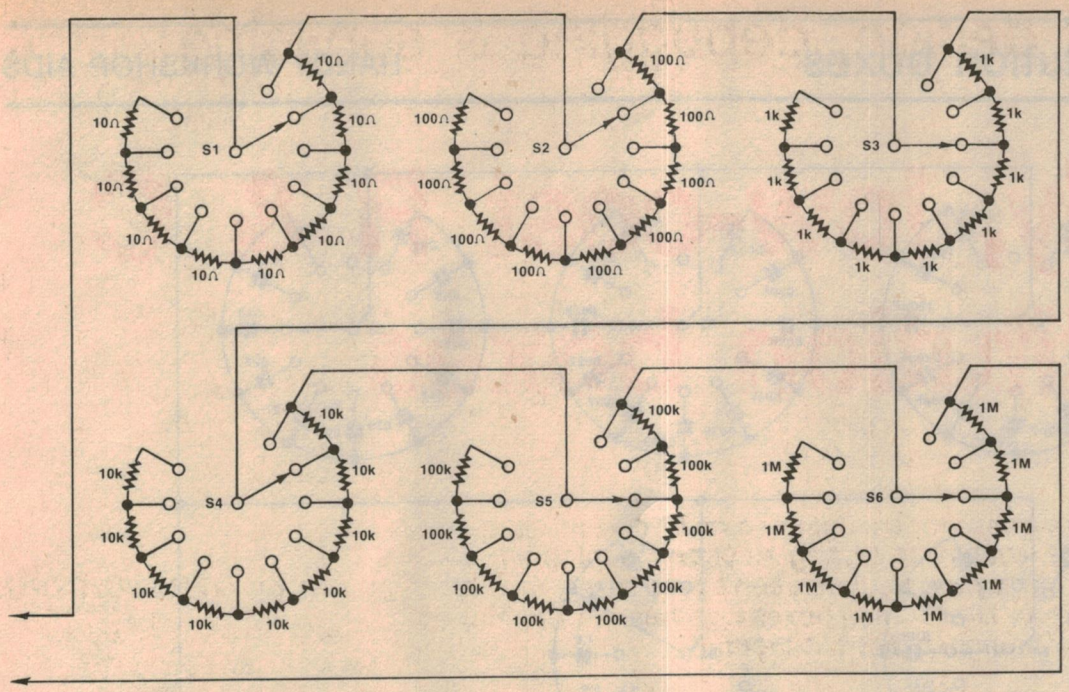
While 5% tolerance resistors will be adequate for the majority of applications, there may be some situations where greater accuracy is required. We used 2% resistors throughout, although there is nothing to stop you from using even 1% resistors if your pocket stretches that far. The resistors we used came from Radio Despatch Service, (869 George St, Sydney), although other parts suppliers should also have close tolerance



A view of the completed resistance unit.



This photograph shows the internal layout and construction of the decade resistance box. Note the tinned copper wire for interswitch connections.



The circuit of the resistance box showing the series connection of the resistors. The switches are also connected in series, giving a maximum possible resistance of 9,999,990 ohms in increments of 10 ohms.

EA DECADE RESISTANCE SUBSTITUTION BOX

7/MS/-

resistors available.

Be warned, though, that 1% and 2% resistors are considerably more expensive than 5% types.

CAPACITANCE BOXES

The three capacitance substitution boxes cover a wide range of values from 100pF to 100uF. The smallest of the three covers the values often encountered in RF work — 100pF to 1000pF — while the second unit offers a much larger selection of values ranging from 100pF to 10uF, and can be considered as a general purpose unit.

The third box substitutes for most of the commonly encountered tantalum electrolytic values, from 0.1uF to 100uF.

To avoid confusion we've referred to the smallest unit as the capacitance substitution box, the 2nd unit covering 100pF to 10uF as the decade capacitance substitution box, and the 3rd unit as the tantalum capacitor substitution box. Let's consider the capacitance substitution box first.

As already mentioned, it has values ranging from 100pf to 1000pF — an entire decade. There are actually 13 preferred values available in this decade but, as there are only 12 positions available on the switch, we had to leave one out. We chose to leave out the 120pF value, as it is the least likely to be missed.

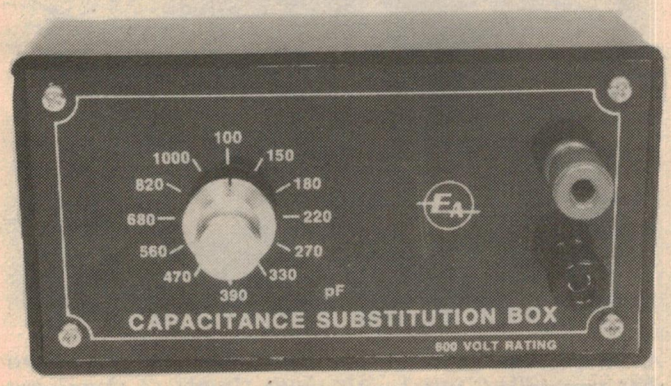
The obvious question at this point is "what type of capacitor should be used here?" Well, there are several different types that will do the job: these include mica and polystyrene types. However, we used miniature-plate ceramic capacitors, which are available in 2% tolerance from Philips.

Normally, ceramic capacitors would not be suitable because their usual tolerance range is too wide. If you cannot get the Philips type, we suggest that you use mica or polystyrene capacitors rated at 600V or higher.

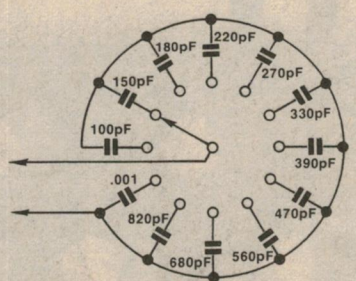
The second capacitance substitution box — 100pF to 10uF — has five rotary switches to provide five decades of capacitor values. Mica, polystyrene or Philips miniature-plate ceramic capacitors are used for values up to 820pF, while metallised polyester types are used for the remaining values up to 10uF. The tolerance rating of this box is ±10% (the tolerance of the polyester capacitors), while the voltage rating is 100V.

Finally, the tantalum substitution box has two rotary switches and a total of 18 preferred values between 0.1uF and 100uF. It has a voltage rating of 6V.

A glance at the circuit diagram will show that the 100uF value has been made up by connecting two 47uF capacitors in parallel. This was done because, at the time, we did not have a single 100uF 6V unit available. Similarly, the 68uF value can be made up of two parallel connected 33uF capacitors if you are unable to purchase a single 6V unit.



Here is the capacitance substitution box used for RF work.



EA CAPACITANCE SUBSTITUTION BOX

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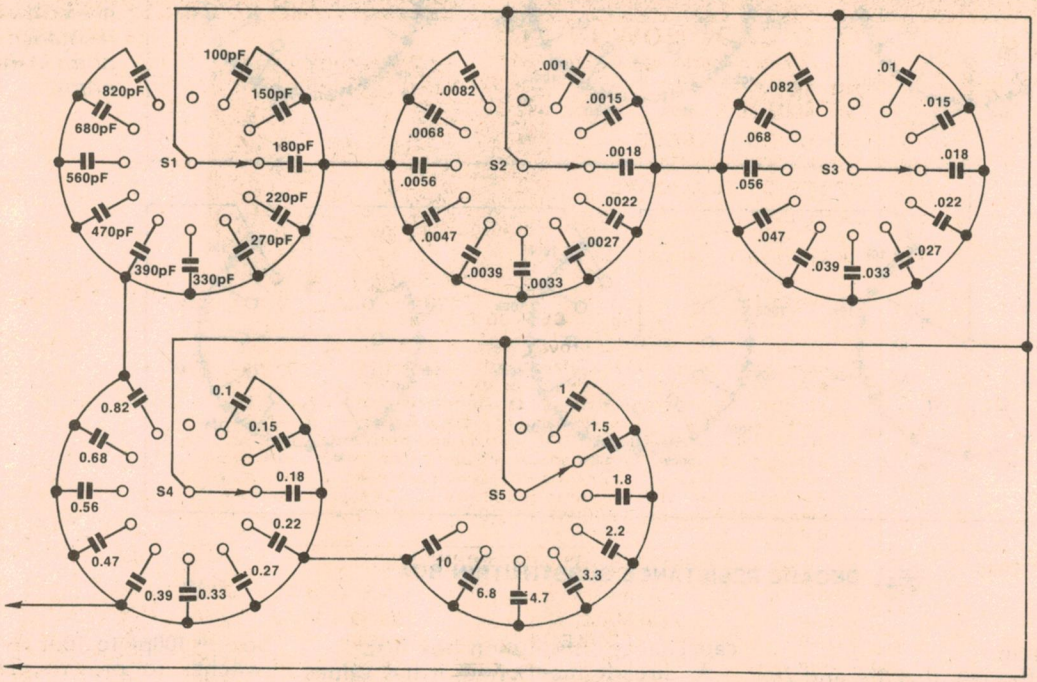
The circuit of this unit is simple, comprising only 12 capacitors and a switch. Despite its simplicity, it can prove valuable for RF work.



This is the circuit of the decade capacitance substitution box. Note: one position on each of the switches is left unconnected, this being position No. 1.

CONSTRUCTION

The circuit diagrams of the four substitution boxes show how the units are wired up, while the photographs give an idea of the actual physical construction. As can be seen, the switches in the decade resistance box are wired in series, whereas the switches in the capacitance substitution boxes are wired in parallel.

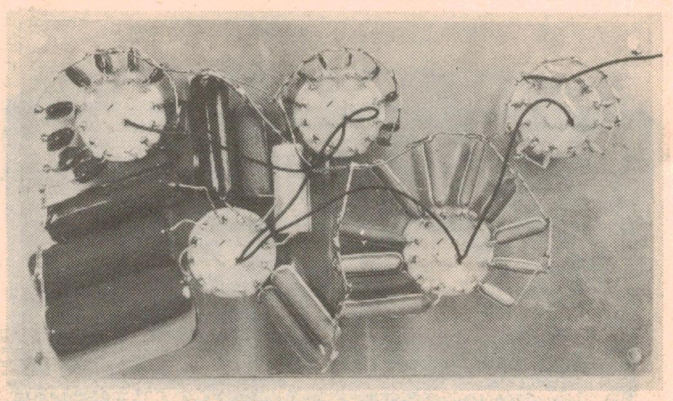
All four circuits are housed in plastic utility boxes fitted with light-gauge aluminium lids. The front panel labels were made from Scotchcal photosensitive aluminium, and ready-made labels should be available from Radio Despatch Service, 869 George St, Sydney by the time this article appears.

The first step in the assembly procedure for each unit is to affix the adhesive Scotchcal panel to the lid of the case and drill the holes for the rotary switches and terminals. Note that the terminals for the two decade boxes are mounted on the top of the case, and must be placed so that they do not foul the front panel rotary switches.

In practice this means mounting them well towards the rear of the case, away from the front panel.

With the rotary switches and output terminals mounted in position, all that remains to do is to wire up the unit according to its circuit diagram. The resistance box is easy — it's simply a matter of wiring nine identical resistors in series around each switch, starting at switch position No. 1. Stout pieces of tinned copper wire were used to make the series connections between the switches, in order to ensure a low resistance path. For the same reason,

The completed decade capacitance substitution box.



An internal view of the decade capacitance unit. We suggest that you follow our layout quite closely as things can become a little cramped with the larger capacitors.

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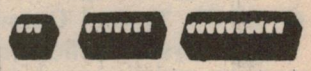

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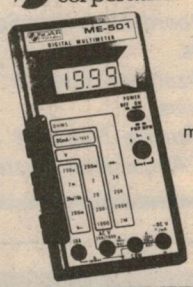

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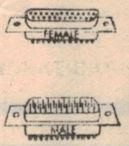
DA-15C	15 PIN COVER	2.30	2.10	2.00
DB-25P	25 PIN MALE	5.90	5.60	5.10
DB-25S	25 PIN F/MALE	6.90	6.60	6.10
DB-25C	1 pc Grey Hood	2.40	2.20	2.00
DB-25C2B	2 pc. Black Hood	2.80	2.70	2.50
DB-25C2G	2 pc. Grey Hood	2.70	2.50	2.40
DC-37P	37 PIN MALE	7.90	7.50	7.10
DC-37S	37 PIN F/MALE	10.90	9.90	9.10
DC-37C	37 PIN COVER	4.90	4.50	4.10
DH/S	Hardware set (2 Pairs)	2.10	1.90	1.80



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As A Kit (without H/phones)	19.90
ET576	4.90
Dream 6800	10.90
ETI 472	2.90
ETI 471	9.90
ETI 470	2.75
ETI Series 4000 Kit	179.00
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ETI 585 Tx ultrasonic Tx	8.95

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ETI 261	$1.50	79TI11	$2.20
ETI 264	$1.50	79SF9	$2.60
ETI 321	$3.90	79PS11	$2.90
ETI 322	$2.75	79se3	$3.90
ETI 452	$5.90	79md9	$2.20
ETI 466	$6.50	80au3	$2.90
ETI 474	$2.20	80cm3A	$2.40
ETI 470	$2.70	80cm3B	$3.50
ETI 471	$9.90	DREAM 6800	
ETI 472	$2.70		$10.90
ETI 541	$2.60	DREAM 6802	
ETI 549A	$2.50		$11.90
ETI 561	$2.75		
ETI 573	$2.90	(Redesigned board	
ETI 576	$4.50	with notes to	
ETI 577	$2.70	eliminate 6875	
ETI 606	$2.30	clock chip)	

Please note all boards are fibreglass 1oz copper precision drilled.

PROJECT BOARDS (FIBREGLASS)

ETI 043	$1.40	ETI 481M	$2.00
ETI 044	1.30	ETI 481PS	3.50
ETI 047	1.50	ETI 483	2.20
ETI 061	1.40	ETI 484	3.90
ETI 062	1.80	ETI 485	2.90
ETI 063	1.70	ETI 486	2.90
ETI 064	1.70	ETI 489A	2.50
ETI 065	1.70	ETI 499	1.99
ETI 067	1.80	ETI 528	2.20
ETI 068	1.40	ETI 541	2.20
ETI 071	1.40	ETI 547	2.20
ETI 072	1.80	ETI 581	2.20
ETI 081	1.50	ETI 583	2.20
ETI 083	1.80	ETI 585R	1.60
ETI 084	1.70	ETI 585T	1.40
ETI 085	1.30	ETI 586	2.30
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ETI 450B	1.90	EA 78T3	4.20
ETI 480	2.40	EA 78C5	3.90
ETI 480PS	2.40		

IC SOCKETS (Low Profile)

	1-9	10-25	100+
8 Pin	.18c	.17c	.16c
14 Pin	.22	.20	.19
16 Pin	.24	.22	.20
18 Pin	.40	.36	.33
20 Pin	.42	.39	.36
22 Pin	.44	.40	.38
24 Pin	.45	.41	.39
28 Pin	.50	.46	.42
40 Pin	.58	.55	.51

All Solder Tail

WIRE WRAP 3-LEVEL

	1-9	10-25	100+
8 Pin	.75c	.65c	.50c
14 Pin	.90c	.85c	.80c
16 Pin	$1.00	.90c	.85c
18 Pin	1.20	$1.10	$1.00
20 Pin	1.40	1.30	1.20
22 Pin	1.60	1.40	1.30
24 Pin	1.90	1.80	1.70
28 Pin	2.20	2.10	2.00
36 Pin	2.60	2.40	2.30
40 Pin	2.90	2.70	2.50

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INTERSIL

ICL7660
Monolithic MAXCMOS®
VOLTAGE CONVERTER

FEATURES
- **Simple Conversion of +5V Logic Supply to ±5V Supplies**
- **Simple Voltage Multiplication ($V_{OUT} = (-) nV_{IN}$)**
- **99.9% Typical Open Circuit Voltage Conversion Efficiency**
- **98% Typical Power Efficiency**
- **Wide Operating Voltage Range 1.5V to 10.0V**
- **Easy to use — Requires only 2 External Non-Critical Passive Components**

APPLICATIONS
- *On Board Negative Supply for up to 64 Dynamic RAMs.*
- *Localized µ-Processor (8080 type) Negative Supplies*
- *Inexpensive Negative Supplies*
- *Data Acquisition Systems*

GENERAL DESCRIPTION
The Intersil ICL7660 is a monolithic MAXCMOS® power supply circuit which offers unique performance advantages over previously available devices. The ICL7660 performs the complete supply voltage conversion from positive to negative for an input range of +1.5V to +10.0V, resulting in complementary output voltages of -1.5 to -10.0V with the addition of only 2 non-critical external capacitors needed for the charge pump and charge reservoir functions. Note that an additional diode is required for $V_{SUPPLY} > 6.5V$.

Typical applications for the ICL7660 will be data acquisition and microprocessor based systems where there is a +5 volt supply available for the digital functions and an additional -5 volt supply is required for the analog functions. The ICL7660 is also ideally suited for providing low current, -5V body bias supply for dynamic RAMs.

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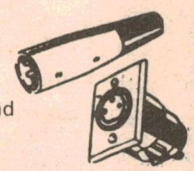

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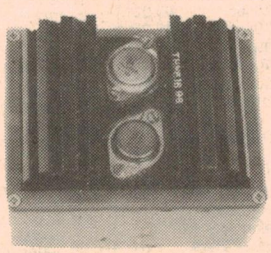

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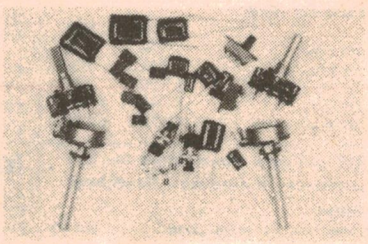

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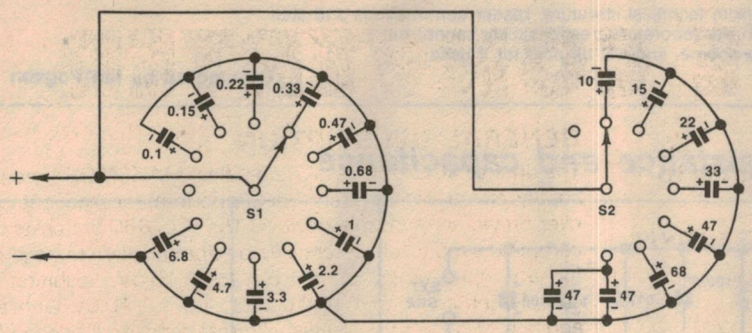


EA TANTALUM CAPACITOR SUBSTITUTION BOX 7/MS/-

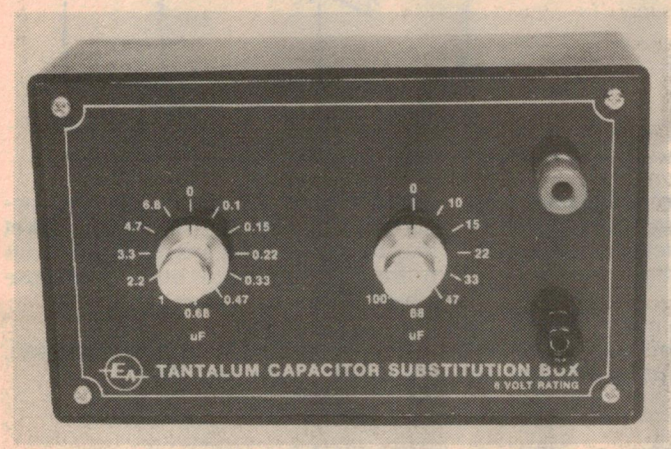
The circuit of the tantalum capacitor box. The 100uF capacitor is made up of two 47uF capacitors in parallel.

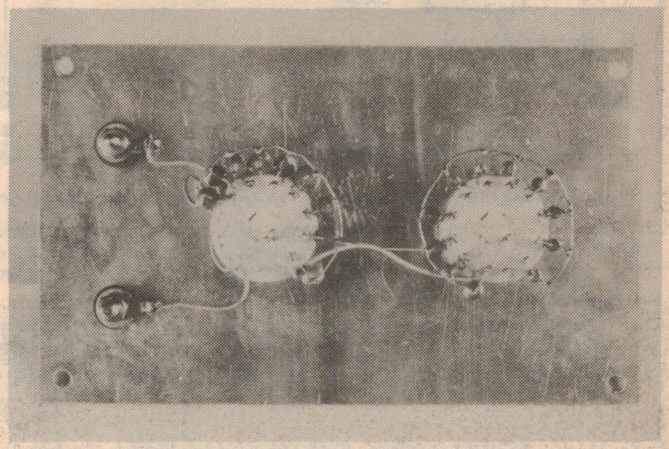
use heavy duty hook-up wire to make the connections to the terminals.

Once construction of the resistance box is complete, the lid may be secured in position. A quick check with a multimeter will soon tell if the unit is correctly wired.

The capacitance substitution and tantalum substitution boxes are also easy to build. The capacitors are all wired between the various switch terminals and a common rail of stout tinned-copper wire that runs around the outside of each switch. This common rail is connected to the black terminal post

(Continued on page 126)





These two photographs show the internal and external views of the tantalum substitution box. The negative electrodes of the capacitors are connected to the common rail.

PARTS LIST

DECADE RESISTANCE BOX

RESISTORS (½W, 2% or 5% tolerance, see text)
9 x 10 ohm, 9 x 100 ohm, 9 x 1k, 9 x 10k, 9 x 100k, 9 x 1M.

MISCELLANEOUS
6 12-position rotary switches
1 plastic utility box, 196 x 113 x 60mm (or equivalent)
2 black binding posts/terminals
Scotchcal label

SMALL CAPACITANCE BOX

CAPACITORS (polystyrene or ceramic, see text)
1 x 100pF, 1 x 150pF, 1 x 180pF, 1 x 220pF, 1 x 270pF, 1 x 330pF, 1 x 390pF, 1 x 470pF, 1 x 560pF, 1 x 680pF, 1 x 820pF, 1 x 1000pF.

MISCELLANEOUS
1 12-position rotary switch
1 plastic utility box, 130 x 68 x 41mm (or equivalent)
2 black binding posts/terminals
Scotchcal label

DECADE CAPACITANCE BOX

CAPACITORS (polystyrene, ceramic & polyester, 100V rating, see text)
1 x 100pF, 1 x 150pF, 1 x 180pF, 1 x 220pF, 1 x 270pF, 1 x 330pF, 1 x 390pF, 1 x 470pF, 1 x 560pF, 1 x 680pF, 1 x 820pF, 1 x 1000pF, 1 x .001uF, 1 x .0015uF, 1 x .0018uF, 1 x .0022uF, 1 x .0027uF, 1 x .0033uF, 1 x .0039uF, 1 x .0047uF, 1 x .0056uF, 1 x .0068uF, 1 x .0082uF, 1 x .01uF, 1 x .015uF, 1 x 0.18uF, 1 x .022uF, 1 x .027uF, 1 x .033uF, 1 x .039uF, 1 x .047uF, 1 x .056uF, 1 x 0.68uF, 1 x .082uF, 1 x 0.1uF, 1 x 0.15uF, 1 x 0.18uF, 1 x 0.22uF, 1 x 0.27uF, 1 x 0.33uF, 1 x 0.39uF, 1 x 0.47uF, 1 x 0.56uF, 1 x 0.68uF, 1 x 0.82uF, 1 x 1uF, 1 x 1.5uF, 1 x 1.8uF, 1 x 2.2uF, 1 x 3.3uF, 1 x 4.7uF, 1 x 6.8uF, 1 x 10uF

MISCELLANEOUS
5 12-position rotary switches
1 plastic utility box 196 x 113 x 60mm
2 black binding posts/terminals
Scotchcal label

TANTALUM BOX

CAPACITORS (tantalum, 6V rating or higher)
1 x 0.1uF, 1 x 0.15uF, 1 x 0.22uF, 1 x 0.33uF, 1 x 0.47uF, 1 x 0.68uF, 1 x 1uF, 1 x 2.2uF, 1 x 3.3uF, 1 x 4.7uF, 1 x 6.8uF, 1 x 10uF, 1 x 15uF, 1 x 22uF, 1 x 33uF, 1 x 47uF, 1 x 68uF, 1 x 100uF

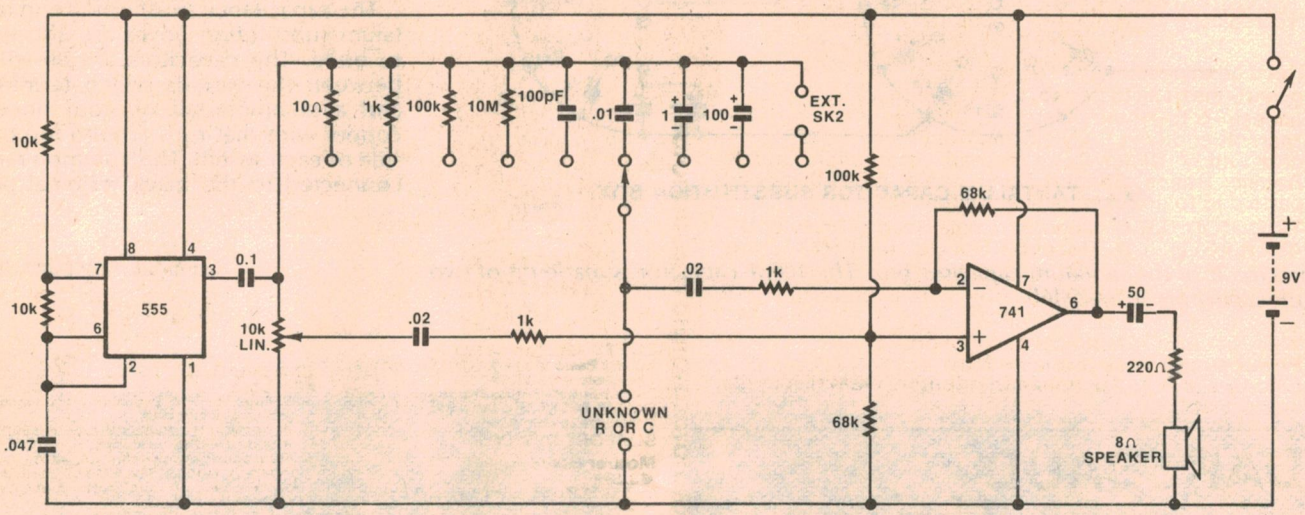
MISCELLANEOUS
2 12-position rotary switches
1 plastic utility box 159 x 96 x 51mm (or equivalent)
1 red binding post/terminal
1 black binding post/terminal
Scotchcal label

CIRCUIT & DESIGN IDEAS

Interesting circuit ideas and design notes selected from technical literature, reader contributions and staff jottings. As they have not necessarily been tested in our laboratory, responsibility cannot be accepted. Contributions to this section are always welcome, and will be paid for if used.

Conducted by Ian Pogson

Bridge measures unknown resistance and capacitance



This bridge may be used to determine, with reasonable accuracy, the value of resistors and capacitors over a very wide range. The bridge is formed by two arms of the 10k potentiometer, the unknown and the reference value as chosen by the switch. The 555 serves as an oscillator in the audio range and the 10k potentiometer is adjusted for a minimum output from the headphones or loudspeaker, as determined by the 741 difference amplifier.

The 10k potentiometer should be calibrated by determining significant points obtained by using resistors or capacitors of known value and accuracy. The external reference socket may be used as a means for testing coils or for different ranges other than those which the switch offers.

(By Mr D. Brighton, Franklin Road, Huonville, Tasmania 7109.)

Improved resistance-capacitance oscillator

In a common form of RC oscillator as show in figure 1, a parallel-T network in a negative feedback loop nulls at one frequency, allowing positive feedback via the potentiometer to sustain oscillation at that frequency. The frequency stability is worse and the harmonic distortion is higher than that of a resonant (inductance/capacitance) oscillator because the bandwidth of an RC network is greater than the bandwidth of an LC circuit.

Unfortunately, inductors are usually large and expensive but a suitably proportioned parallel-T network can, with the addition of an extra resistor and capacitor, produce two outputs, one at point A (figure 2), a voltage which nulls at one frequency and the second at point B, a voltage which peaks, and is in phase with the network input voltage, at the same frequency. Positive feedback can now be taken from point B, giving a measure of frequency discrimination to the positive feedback loop and narrowing the overall oscillator bandwidth.

A comparison of measurements made on the two circuits shows the improvement to be expected. Standard tolerance resistors and capacitors were used. Better results can be obtained by using matched components, or by using trimpots for R3 and R4. Both circuits were adjusted to give an output voltage of 4.5V P-P.

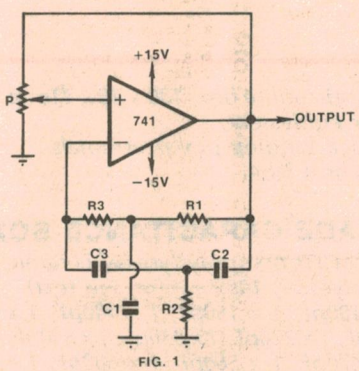


FIG. 1

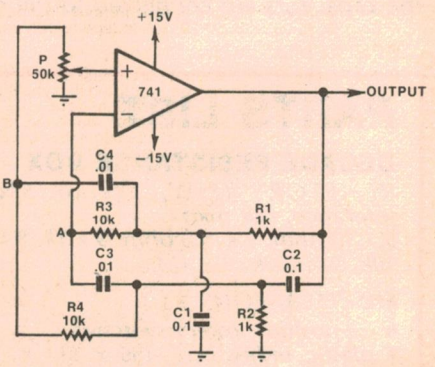


FIG. 2

The frequency stability for a 10% supply voltage change was 0.17% for figure 1 and .011% for figure 2. Harmonic distortion was measured at 2.2% and 0.55%, respectively.

The choice of frequency, 1591.5Hz, may seem unusual but has been deliberately chosen as part of an impedance meter, to simplify calculations of inductive and capacitive reactance. Provided the parameters given below are observed, an oscillator of any frequency may be made.

R1 = R2 = Xc1 = Xc2

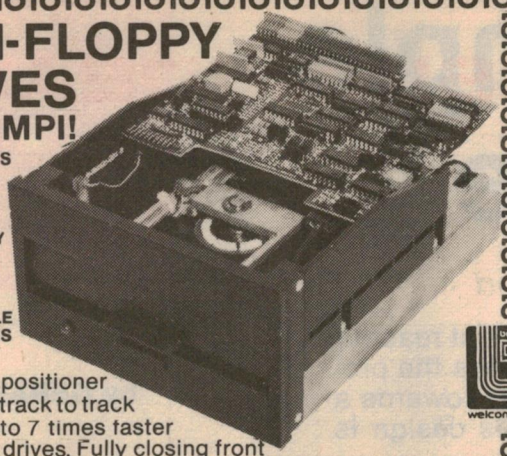
R3 = R4 = Xc3 = Xc4 = k1R1, where k is equal to or greater than 10

P = k2R3, where k2 is equal to or greater than 5

X is the reactance at the frequency of oscillation, fo.

(By Mr R. Salter, 12 Ayr Street, Macleod, Victoria 3085.)

MINI-FLOPPY DRIVES FROM MPI!



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Power supply/case available May
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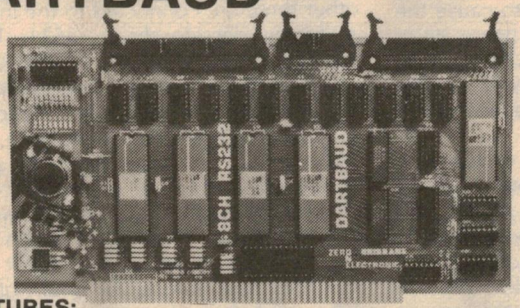

FEATURES:
- 8 Independently selectable 1/0 channels
- 2 Eight bit parallel ports
- RS-232 Interface levels
- Async or optional synchronous channels
- Baud rates 50-19, 200 independently selected for each channel

SPECIFICATION:

Serial Ports: 8 Independent ports using Zilog D/ARTs (sync) or optionally S10/0 (may be retrofitted for synchronous parts. for any pair (S10 and DART are dual devices).

Baud Rates: 6 Independent, crystal-controlled, software selectable rates for each port selected from the 16 standard rates between 50 and 19,200 baud.

Parallel Ports: 2 Independent ports using Zilog P10, selectable as either input or output.

Interrupts: Full on-board interrupt control provided. On-board devices daisy chained. Rotating priority control provided for running multiple boards (through top connector). Jumper selection of interrupt control (local, rotating, vectored). **PRICE: POA & MANUAL AVAILABLE**

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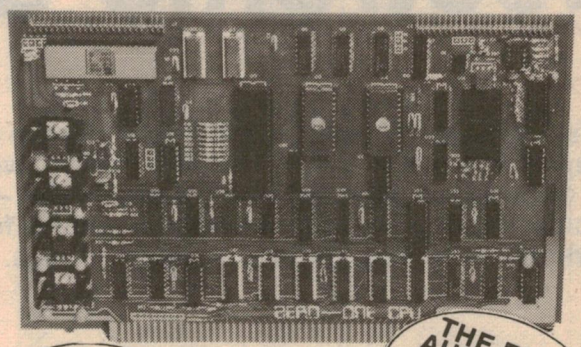

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THE ZERO ONE DYNARAM II
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- Refresh completely transparent using bus signals to derive refresh allowing processor to run at full speed without wait slates
- Supplied on minimum of 1 x16k Blocks expandable by merely plugging in extra rams.

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ETI 640 VDU kit fully socketed $139
Please note that 200ns memories are required for VDU 4MHZ operation at $6.00 extra or 10 x 21L02-2 for $26.00 separately.

Z80 CPU CARD
FEATURES —
- Comes with full assembly instructions and card documents.
- Power on jump for automatic execution of monitor program on startup.
- Front panel-less operation allowed by on board 2k monitor which is too good to explain here; 19 commands all unique abbreviations allowed.
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- 1/0 Z80 P10 2 x 8 bit programmable parallel 1/0.
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- Keyboard input direct onto card in parallel ASCII.
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PRICE KIT $199.50 2MHZ
$225.00 4 MHZ
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Exorciser 32/16 channel A/D Convertor
2650 users! 24k static card bus compatable KT9500
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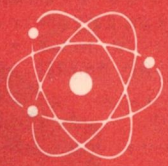
Build this simple electronic die

Basic Electronics



Here's a simple electronic die that has a seven segment readout to display the result of a throw. The design overcomes the problem often associated with an electronic die — bias towards a particular result. The distribution of results for this design is remarkably even and appears to have no bias.

by GERALD COHN

Even with all the variety available to us today, particularly in the way of electronic games, there is still a strong attraction to games of chance, in particular those employing a die or a pair of dice. However, many arguments have been caused by the penchant for normal dice to give apparently biased or ambiguous results, particularly when the fever of the game is running high.

The readout of our electronic die is in the form of a seven segment display which is used to display the digits one to six inclusive, representing the six sides of a conventional die. In all, three ICs are employed in the circuit and the construction is made simple by the use of a printed circuit board.

Now, let's take a look at the circuit and see how it works. The circuit can be broken up into three separate sections, an oscillator, a counter, and the display circuits.

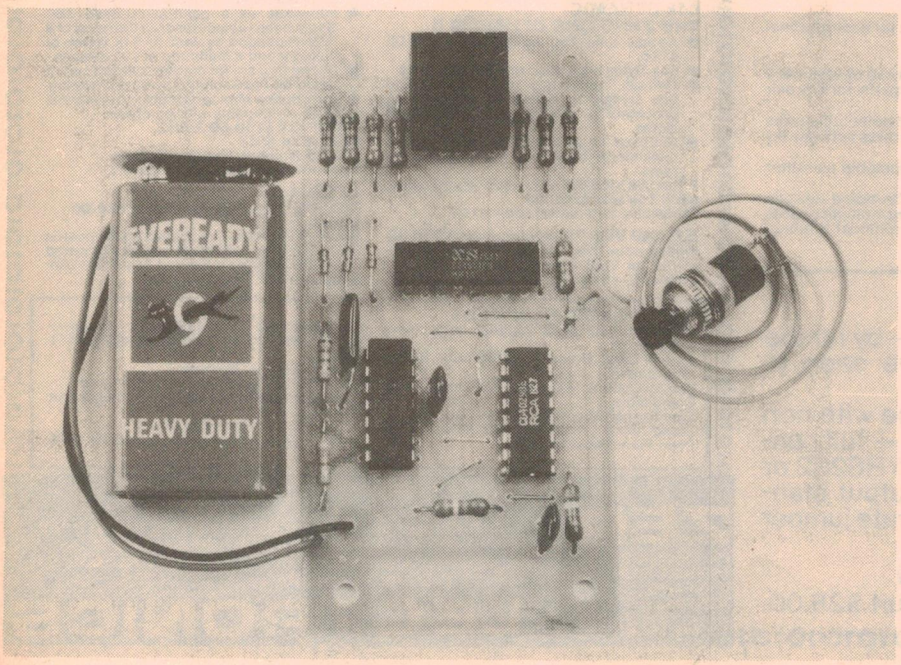
The oscillator is a typical three-gate type, in this case made up using three of the available six inverters in a 4069 IC package. Operation of the oscillator circuit is simple: if we assume the output of the oscillator to be at a logical high level, then the input to last inverter in the chain must be low. The capacitor charges up until the voltage across it is equal to the required voltage at the input to the first inverter to cause the outputs of all the inverters to change state; the capacitor now begins to charge up in the opposite direction. This cycle repeats itself for as long as power is applied to the circuit.

The counter following the oscillator is the CMOS 4029, a four bit counter with the capacity to count from zero to 15. But, there are some special control inputs to the counter that allow us to use the device in a number of different modes. We can for example choose whether the counter is to count up from zero, or down to zero. A single pin on the IC controls the direction of the count.

Since we are using the counter as a die, we only require it to count up to six and then reset to start from one. This is accomplished using only the first three least significant outputs from the counter, the fourth not being needed. We have left the fourth output unconnected, while the other three are connected to the inputs of a display decoder/driver, 4511. This IC takes the binary output of the counter and decodes it to drive a seven segment display. Also connected to the counter outputs is a three diode AND gate.

We are in fact using the AND gate to detect the count of seven. Since it is desired to display the digit "six", we have had to actually count up to seven before the reset takes place. Here's how it works: the AND gate detects the count of seven (all outputs from the counter high). When this condition occurs, the output of the AND gate goes high and after buffering by two inverters applies a pulse to the preset enable input, loading "one" into the counter registers (via the preset enable, pin four). The counter begins to count from one again, but the thing to remember is that the counter resets almost instantly when the preset pulse appears at the preset enable input, so "seven" never appears.

We have used the latching function of the 4511 decoder/driver for the "throw" pushbutton. When the button is depressed, the latch enable (LE) input is taken low,



Above is a view of the completed electronic die. It's easy to built, with all components (except for the battery and switch) mounted on a PC board.

We estimate that the current cost of parts for this project is approximately

$10.00

This includes sales tax.

thus allowing the data at the inputs to pass straight through to the outputs. When the button is now released however, the level at the LE input changes to high, and the data that last appeared at the inputs the moment that the LE input was taken high is latched into the flipflop memory. This latched data will be displayed until the button is again depressed.

We used the blanking input of the 4511 to conserve the battery. This is done by connecting the clock output (from the oscillator) to the blanking input and thus turning the display on and off at the rate of about 10kHz. Since the clock output has a duty cycle of about 50% (ie, it is a square wave) it cuts the battery drain due to the display by about half. The total current drain is actually 23 milliamps.

The display we used is the commonly available FND-500. This has a common cathode line, the anodes being driven by the outputs of the decoder IC via 560 ohm resistors to limit the current through the segments to approximately 10mA.

CONSTRUCTION

The unit is constructed on a printed circuit board (80d6) measuring 48 × 94mm which accommodates all components with the exception of the battery and the push button.

When assembling the PCB refer to the component overlay diagram taking special note of the orientation of the ICs, the display and the diodes. Start by first inserting the seven wire links and soldering these to the board, followed by the resistors and the capacitors.

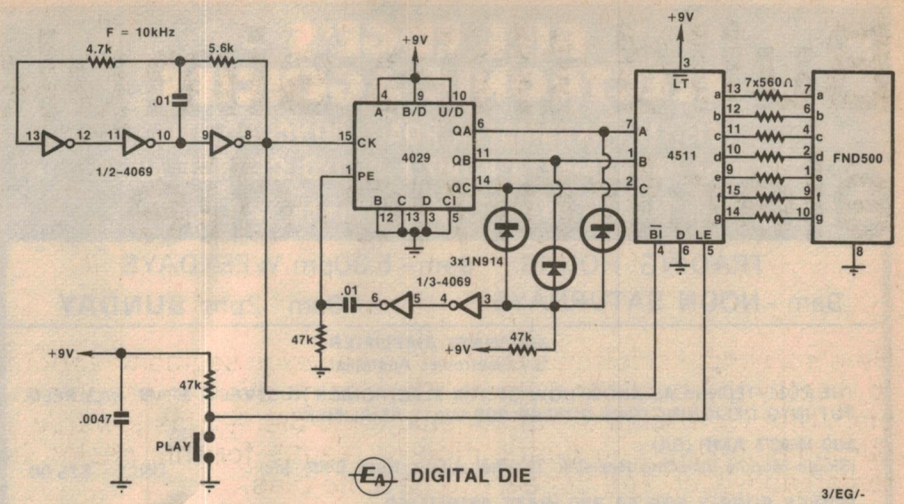
The last components to go on the board are the semiconductors: first the diodes and then the ICs. When you solder the ICs to the board, start by soldering the supply pins first, and then proceed to solder the remaining pins to the board. The reason for this is that the CMOS ICs are susceptible to damage from static discharges, and soldering the supply pins first goes a long way to preventing any damage.

When you have finished assembling the board, go back over it, looking for solder bridges between adjacent copper tracks, dry joints, and unsoldered components. Then turn the PCB over and do a final check to see that all components have, in fact, been properly placed. When you have satisfied yourself that all is OK, solder the battery clip and pushbutton wires to the board.

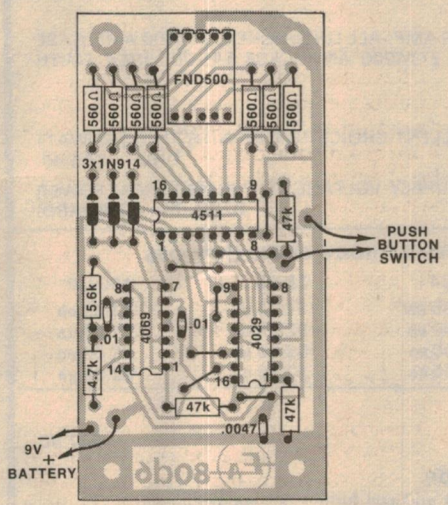
Testing is easy – just clip the battery in place and press the pushbutton. The display will show the figure "eight". The reason for this is due, as you will remember from earlier discussion, to the fact that when the latch enable input is taken low, the data at the inputs to the decoder flows straight through to the outputs to be displayed. The "eight" is due to all the segments turning on and off at a 10kHz count rate. When you now release the button, the display will show any of the digits between one and six inclusive.

All that needs be done now is to house the PCB in some sort of box. We have left this up to the constructor to do since he may have a special way of wanting to house it. The board was sized to fit into one of the plastic utility boxes, and it can be housed in one of these or it may be mounted into the "family" gaming table.

Anyway, whichever way you choose to house it, one thing is certain – no one can say the die is biased. Lot's of luck, and good betting!



The circuit consists of three sections: an oscillator, a counter and the display.



Solder the power supply pins first when mounting the CMOS ICs. These are pins 7 and 14 for the 4069, and pins 8 and 16 for the 4029 and 4511.

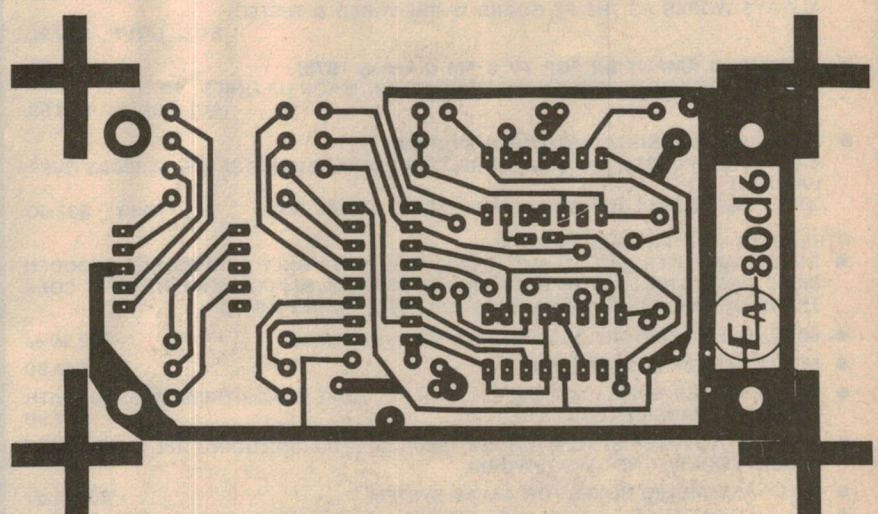
PARTS LIST

SEMICONDUCTORS
1 x 4029 4-bit counter
1 x 4069 hex inverter
1 x 4511 seven-segment decoder/driver
1 x FND-500 seven-segment display
3 x 1N914 diodes

CAPACITORS
2 × .01uF greencap (metallised polyester)
1 x .0047uF greencap

RESISTORS
3 x 47k, 1 x 5.6k, 1 x 4.7k, 7 x 560 ohm

OTHER
1 printed circuit board 80d6, 48 x 94mm
1 pushbutton (normally open)
1 type 216 nine volt battery and clip to suit



Here is an actual size reproduction of the PC pattern.

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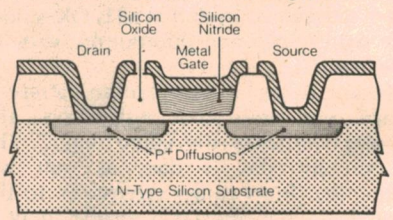

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Hee-haw siren for toy cars

Basic Electronics

by GERALD COHN

How about this for a natty idea? — it's a simple electronic circuit which, when fitted to a toy car or tricycle, will provide a realistic "hee-haw" siren sound and flashing lights. The circuit uses just two low-cost ICs and a handful of other components, and will only take about half an hour to build.

Of course, our new Hee-Haw Siren is not limited for use in toy fire engines and police cars. It can also be used in more serious applications, such as car or boat burglar alarm systems, or in any other situation that requires an attention-grabbing alarm sound. We're sure that many readers will already have their own application in mind.

In all fairness, though, we should give the reader a few words of warning. The sound produced by our Hee-Haw Siren is a true hackle-raising "hee-haw, hee-haw, hee-haw, hee-haw ..." It's absolutely guaranteed to turn even the most docile, peace-loving adult homo-sapien into a murderous Neanderthal in the space of five minutes (or less). Naturally, the kids will love it!

So unless you are a particularly tolerant type, we suggest that you fit a normally-off pushbutton switch in series with the supply rail to the siren. That way, the alarm will sound only when the child has his finger on the button. As well as providing you with some welcome intervals of peace, this feature will also serve to increase battery life.

How it works

Let's take a look at the circuit and see how it works. It's really very simple and consists of three audio oscillators (IC1a, IC1b and IC1c) which drive the LED display circuitry and a small audio amplifier. The two tone oscillators, IC1a and IC1c, are set to run at the desired audio frequencies to give the "hee" and "haw" sounds, while rate oscillator IC1b determines the switching rate of the two tones.

Each oscillator is based on a single inverter from a 74C14 hex Schmitt inverter IC package, together with two external components – a feedback resistor and a capacitor. These external components set the oscillator output frequencies.

So how does the oscillator work? Well, a Schmitt trigger is a device with two widely spaced trigger voltages – an upper trigger voltage and a lower trigger voltage. The output of the device changes state only when the upper trigger voltage is exceeded at the input, or when the applied input voltage drops below the lower trigger voltage.

Applied input voltages between the two trigger points cause no change at the output, an effect referred to as hysteresis. A Schmitt trigger exhibits a considerable amount of hysteresis, and it is this characteristic that enables the construction of an oscillator using just one inverter.

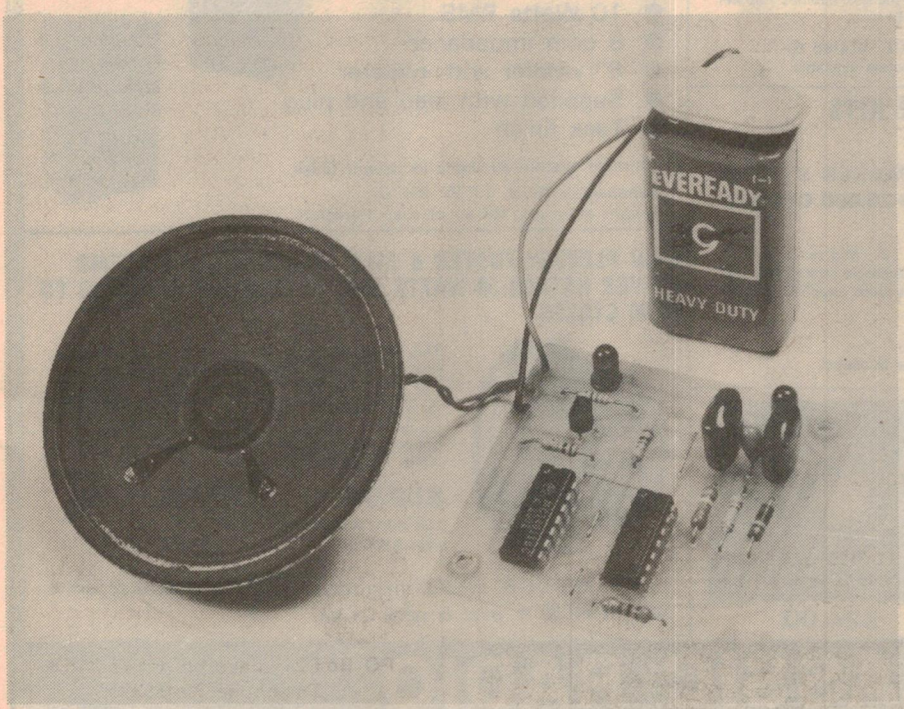
As can be seen from the circuit diagram the feedback resistor is connected between the input and output, while the capacitor is connected between the input and ground. What you have to remember now is that the input and the output of an inverter are always 180° out of phase; ie when the input is low the output will be high, and vice versa.

Let's initially assume that the input of the inverter is low and that the output is high. The capacitor on the input will now charge via the feedback resistor until it reaches the upper trigger voltage and switches the output of the inverter low. At this point, the capacitor discharges via the resistor into the output until its voltage reaches the lower trigger point. The inverter then switches over again, and so the process continues indefinitely.

As already mentioned, the resistor and the capacitor values set the oscillator frequencies. For the prototype, the values shown give a high tone frequency of 1kHz, a low tone frequency of 385Hz, and a rate frequency of about 2Hz. These frequencies result in a sound similar to that produced by a police siren.

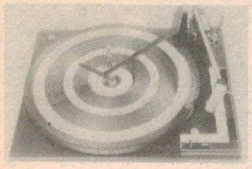
You can change the various oscillator frequencies simply by changing the values of the feedback resistors. Some constructors may even prefer to replace the fixed value resistors with trimpots so that they can adjust the sound just the way they want it. Suitable trimpot values would be 100k for the two tone oscillators and 1M for the rate oscillator.

The output of the high tone oscillator is fed to one input of NAND gate IC2a while



The Hee-Haw Siren can be fitted to a child's toy or used in a burglar alarm system.

SPECIAL PURCHASES



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(SEE REVIEW EA FEB 1980)

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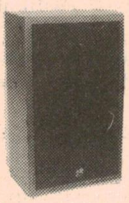

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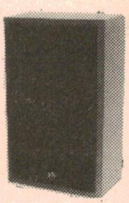

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A similar system available in walnut finish.
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$59.00
(List price was over $100.00)

Post & packing
NT & NSW $3.50
Q, Vic, SA $5.50
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Per kit

Foster C00F05 8" woofer max power 80w available as separate unit at **$47.50** + post & pack as kit.

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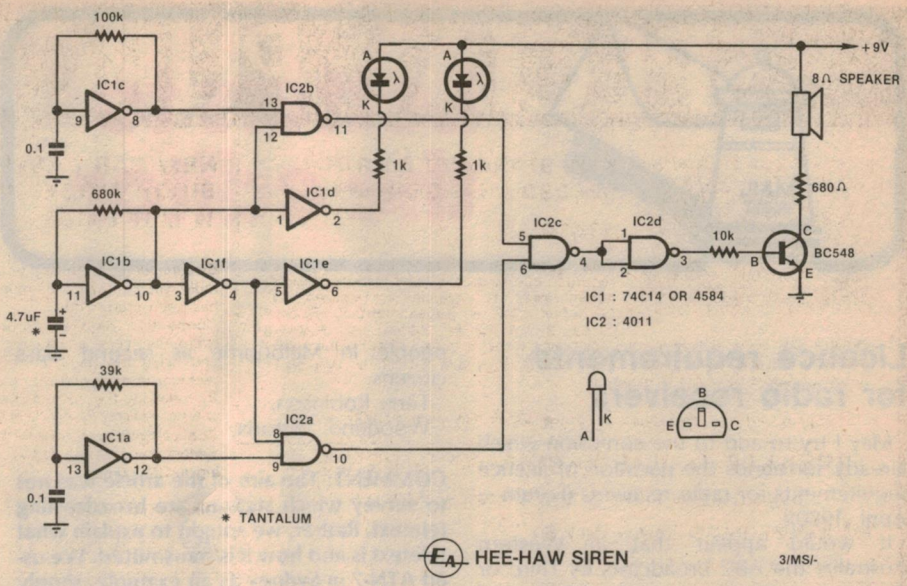
245 PARRAMATTA RD, HABERFIELD 2045. PHONES 798-7145, 798-6507.

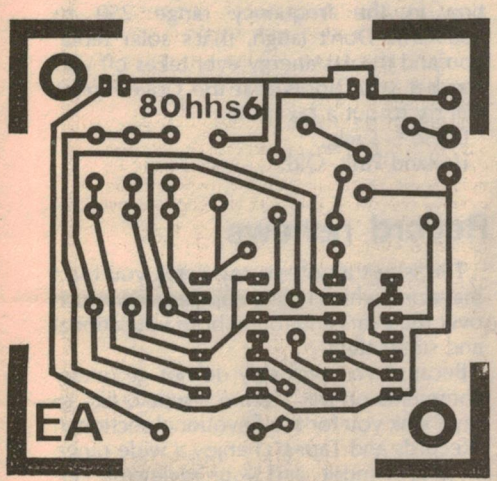
Hee-Haw Siren

NAND gate IC2b is fed by the low tone oscillator. The remaining input to each of these two gates is connected to the rate oscillator, directly in the case of IC2b and via inverter IC1f in the case of IC2a. Inverter IC1f ensures that only one tone is gated through at any given time.

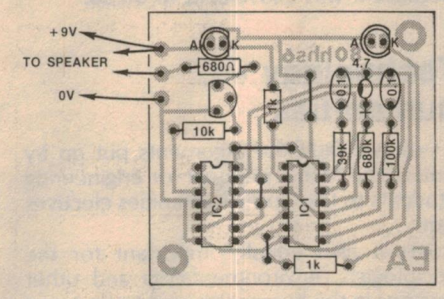
In practice, this means that the high tone oscillator output is gated through to IC2c during negative half cycles of the rate oscillator, and the low tone oscillator output is gated through during positive half cycles.

The output of the mixer gate, IC2c, is fed to both inputs of IC2d, used here as an inverting buffer, and from there to a small audio amplifier. Strictly speaking, IC2d is not really necessary. We have used it simply because it would otherwise be left spare and because it provides additional signal squaring for the following amplifier stage.





Actual size reproduction of the PC board.



This overlay diagram shows the PC board as viewed from the component side.

We estimate that the cost of components for this project, including the battery, is approximately

$8.00

This includes sales tax.

PARTS LIST

1 PC board, code 80hhs6, 59 x 56mm
1 74C14 or 4584 hex Schmitt inverter
1 4011 quad 2-input NAND gate
1 BC548 NPN transistor
2 red LEDs
1 type 216 9V battery and battery clip
1 miniature 8 ohm loudspeaker
1 on-off switch (optional)

CAPACITORS
1 x 4.7uF/16VW tantalum
2 x 0.1uF metallised polyester

RESISTORS
1 x 680k, 1 x 100k, 1 x 39k, 1 x 10k, 2 x 1k, 1 x 680 ohms.

NOTE: Ratings are those used on the prototype. Components with higher ratings may generally be used provided they are physically compatible.

The amplifier is about as simple as you could get and consists of a single BC548 NPN transistor wired in common-emitter configuration. A 10k resistor limits the transistor base current, while a 680 ohm resistor and an 8 ohm loudspeaker form the collector load. Power output is less than 1mW but this should be sufficient for most purposes. If not, reduce the value of the 680 ohm resistor but remember that this will increase the current drain.

Finally, we have made for provision on the circuit for two LEDs which flash on and off in sympathy with the rate oscillator. These are driven from the output of the rate oscillator via the two remaining inverters in the 74C14 package, IC1d and IC1e. Thus, whenever the output of the rate oscillator goes high, the output of IC1d will go low and the LED corresponding to the low tone will be turned on. Similarly, when the rate oscillator output goes low the LED corresponding to the high tone will be turned on.

Construction

Construction of the unit is simple and straightforward. As can be seen from the photograph, the unit is built up on a small PC board coded 80hhs6 and measuring 59 x 56mm. This board accommodates all of the circuitry except for the battery and the speaker.

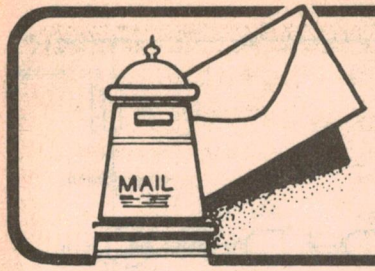
Commence construction by fitting all components except the two ICs to the PC board. Don't forget the three wire links and watch the orientation of all polarised components. Included here are the 4.7uF tantalum capacitor, the two LEDs, and the BC548 transistor.

Note that although we have shown the two LEDs mounted directly on the board, there is nothing to stop you from connecting them via short lengths of hook-up wire. In fact, it will probably be necessary to do this if the unit is to be installed in a toy car.

The two ICs are CMOS devices and should be left till last. When soldering them into circuit, earth the soldering iron barrel to the earth track on the board using a small clip lead and solder the power supply pins (pins 7 and 14) first. These precautions are to prevent possible damage to the ICs by static charges. Make sure that you solder the ICs into circuit the right way round.

Once construction is complete the unit can be switched on and tested for correct operation. The low tone should be heard from the speaker the moment that power is applied to the circuit. After a short time the siren will switch over to the high tone, at which point the circuit will settle down to the proper switching frequency for the rate oscillator. Note that the switch-on tone lasts longer than subsequent tones because the 4.7uF capacitor is initially completely discharged.

Assuming that all is well, it only remains to fit the unit to that toy fire engine or police car. Happy hee-hawing!



Letters to the editor

Licence requirements for radio receivers

May I try to add to the confusion which already surrounds the question of licence requirements for radio receivers (Forum – April, 1980)?

It would appear that in Western Australia, the ABC broadcasts its Third or Regional program on 6.14, 9.61 and 15.425MHz at various times of the day. Presumably, this is intended to supplement the service provided by its medium-wave regional transmitters to cover remote parts of the state.

I was assured over the telephone when confirming these frequencies that this is a purely domestic service and not intended for overseas shortwave listeners.

In view of the above, it would seem to me that if a licence is not required for a broadcast band receiver, then this provision should also extend to cover the shortwave bands.

J. H. Emery,
Bull Creek, WA.

COMMENT: What you say is correct. The use of shortwaves for some domestic services has been one more aspect of past confusion.

Teletext & Melbourne readers

Thank you for a very interesting magazine which I have been receiving now since about 1964. Now, reading through the latest issue, I noticed an article on teletext. I am very interested in this subject and have seen demonstrations of it in Melbourne. However, your article, whilst telling of the Sydney teletext broadcasts, did not make any mention of similar broadcasts in Melbourne. Is this known by you, or did you not think it was important for those readers outside NSW?

Now I am quite aware that many people in your state (NSW) are convinced that Australia begins at the Gold Coast and ends at Albury, but surely a magazine such as EA should be appropriate for all readers in Australia. In fact your title suggests it. Perhaps you should re-name the magazine "Electronics Sydney" and limit distribution to NSW.

I am quite aware that Melbourne television is not nearly as good as it once was and most of the programs are now relayed from your city, but this is no reason to treat people in Melbourne as second class citizens.

Terry Robinson,
Woodend, Victoria.

COMMENT: The aim of the article was not to survey which stations are broadcasting teletext. Rather, we sought to explain what teletext is and how it is transmitted. We used ATN-7 in Sydney as an example, simply because it was convenient to do so.

Technology vs. humanities

I cannot fault the arguments put up by you in the March editorial for engineering students to take some humanities electives but . . .

Isn't it also equally important for the sociologists, environmentalists and other persons in the humanities area to do some elementary engineering studies?

Hopefully, this would help them to make their decisions for or against mining, nuclear power and industrial development more on the facts of life and less on emotive grounds.

Some of them still refuse to accept the truth of the quotation from Mao Tse Tung that "there can be no construction without destruction".

Westralian.

(Name and address supplied but withheld at the request of the writer).

The Wireless Telegraphy Act

I would like to comment on your Forum article "Listeners, Licences and Legalities" in the April, 1980 issue of EA. While it is obvious that laws are required to prevent uncontrolled radio transmissions from cluttering the airwaves and interfering with legitimate services, I can see no possible justification for any laws relating to the reception of radio signals. Radio signals by their very nature engulf us all, whether wanted or not, and can be received by anyone with suitable equipment. Since reception is purely passive there is no interference to any legitimate transmission.

The secrecy provisions of the Wireless Telegraphy Act, as pointed out in your article, are ludicrous. Broadcasting a message by radio is like talking to your neighbour across the street by standing on the rooftop and shouting through a megaphone. Expecting anyone who happened to overhear such a conversation to be sworn to secrecy and not to make use of any information obtained is utterly absurd. The onus for security must rest with the person transmitting the information if he wishes it to remain secret. There are adequate methods available ranging from simple scrambling to complex data encryption to maintain security from everyone from the casual listener to the determined eavesdropper.

The licence fee situation for reception of radio signals is just as objectionable. If the Government is going to demand a licence fee merely for reception of signals of a particular frequency, then I surely have an equally reasonable right to refuse to pay it and to demand that they prevent these unasked-for radiations from trespassing inside my radio receiver and my person. I'd like to see them do that – perhaps a suit of medieval armour might be an effective personal screen!

And if we don't watch out they'll amend the Wireless Telegraphy Act to require a licence to receive electromagnetic radiation in the frequency range 250 to 1000GHz. Don't laugh, that's solar radiation and if solar energy ever takes off you can bet your boots that the Government will try to put a tax on it!

David L. Craig,
Holland Park, Qld.

Record reviews

This is just a note to say thank you for a magazine which I have enjoyed very much over the years and found both educational and stimulating.

Because you probably do not get many comments on this feature, I would like to say thank you for the devotional section in "Records and Tapes". I enjoy a wide range of gospel music and your reviewers certainly cover the whole spectrum in an interesting and informative manner, keeping those of us with precious little to spend on records up to date with what is coming out.

Thank you for your willingness to publish material for special interest groups – a willingness often not demonstrated by editors.

Graham D. Wright,
Salisbury East, SA.

Changes to LCD clock

With reference to the article in your April (1980) issue featuring the LCD clock module sold by Dick Smith Electronics, I would like to advise that the module currently being supplied does not operate in the 24 hour mode. Also, the new unit is of slightly different appearance, although it has the same pin connections as the original featured in your article.

We apologise to any of your readers who may have been inconvenienced by this change.

David Glover,
Marketing Services Manager,
Dick Smith Electronics.

REVIEWS OF RECENT

Records & Tapes

CLASSICAL ● POPULAR ● SPECIAL INTEREST

GRANADOS — GOYESCAS: 'Bewitching charm'

GRANADOS — Goyescas. Parts One and Two (Complete) with El Pelele (The Straw Doll as an extra). Alicia de Larrocha (piano). World Record Club Stereo Disc World Record Club R 06064.

Granados, who perished at sea as a result of a U-boat attack during World War 1, showed every sign of developing into a first class composer. The music he did compose during his relatively short life was Spanish yet quite different from that of his many competitors who relied mostly on native dance rhythms to give their music the required Iberian flavour. So did the many contemporary non-Spanish composers who imitated the "Spanish" style in the same way — Rimsky-Korsakov, Ravel, Debussy, Chabrier and many others.

These piano pieces — Granados also wrote an opera based largely on them — were inspired (as their name suggests) by various works of the great Spanish painter Goya. Most of them are about women in love and, although the whole suite of six is rarely heard today, "The Beauty and the Nightingale" still figures in many pianists' recital programs. All are characterised by luscious melody, deftly passed from hand to hand through an always picturesque accompaniment. They are not easy to play, even though they seldom sound showy. To present them satisfactorily the player needs a beautiful singing tone and unswerving concentration.

In this recital Ms de Larrocha displays both, in a performance of quite bewitching charm. One of her major triumphs is that she makes them sound so deceptively simple. The piano tone is absolutely faithful, and even the tiniest inflection is there without advertisement.

I am not exaggerating when I write that Ms de Larrocha grabs your attention during her very first bars and holds till the very last. The delicacy of her expression gives every piece its own gentle characteristic, some in a whispered lovers' conversation, others more passionately pleading, some even rapturous. And lightheartedness is never overlooked.

If you acquire this disc — and I urge you

to — you needn't play the whole suite of six pieces at one sitting. Choose any one you like and enter this magic world, which concludes with an extra trifle called "The Straw Doll", an ironic piece of painting used sometimes as a prelude and sometimes as an epilogue. (J.R.)

For information on World Record Club albums, contact the club at 605 Camberwell Road, Hartwell, Victoria, 3124. Tel. 29 3636.

POULENC: Gloria and Piano Concerto

POULENC — Gloria. Norma Burroughs (soprano) with the City of Birmingham Chorus and Symphony Orchestra conducted by Louis Fremaux. Piano Concerto. Christina Ortiz (piano) with the Birmingham Orchestra conducted by Fremaux. World Record Club quadraphonic compatible stereo disc QR 06036.

Poulenc was one of Les Six, the Parisian group of the 1920s and perhaps its most enduring member. Much of his success was due to his Boulevardier type, mocking, bitter-sweet frivolities. But he also had his serious side — that of a singularly devout Roman Catholic, who frequently left his beloved Paris to worship at the shrine of

the Black Madonna at Rocaamadour, several leagues distant. Indeed his output of religious music was as great (if perhaps less well known) as his more flippant pieces.

This happy Gloria dates from as late as 1959. Its happy mood is caught to perfection by Louis Fremaux, quite without frivolity. Matching the perfection of his style is the voice of Norma Burroughs whose clear steady soprano perfectly suits this very French music. She is particularly delightful in the Domine Deus where her shining voice is so exquisitely accompanied by the City of Birmingham Chorus and the Birmingham Symphony Orchestra, from whom we get too small a repetoire of discs and cassettes. The balance between all departments is always stable and sensitive. Indeed, the whole Gloria is at once both happy and serene — and deliciously musical.

The Piano Concerto is so tuneful and elegant that one wonders just why it is ignored on so many pianists' programs instead of the endless repetitions of the German Romantics that appear year after year. Perhaps it sounds too easy — which it most certainly isn't when played with elegance of Christina Ortiz. One smiling melody follows another in unerring contrast with, of course, Poulenc's occasional excursions into larrikinism. Here is the music of the Parisian boulevardier, his mind far from the church and other matters of the moment. The finale is a gay as all get out. Highly recommended, especially to those to whom seemingly unending repetitions of Brahms and Beethoven are beginning to pall. (J.R.)

Reviews in this section are by Julian Russell (J.R.), Paul Frolich (P.F.), Neville Williams (W.N.W.), Leo Simpson (L.D.S.), Norman Marks (N.J.M.), Greg Swain (G.S.), and Danny Hooper (D.H.).

WEBER — Konzertstuck in F Minor for Piano and Orchestra.

LISZT — Piano Concerto No. 2 in A Major. Robert Casadesus (piano) and George Szell conducting the Cleveland Symphony Orchestra. Odyssey Stereo disc ODA 5132.

I have always thought of Robert Casadesus as in the upper echelon of Mozart, Chopin and Debussy exponents rather than a player of the two showy pieces he offers here. But, even here, he still maintains the restraint and good taste so temptingly offered to betray him into cheapening his style.

Even though this recording was not copyrighted until 1978, it must nevertheless be fairly old, since Szell died some years ago. And because the recording reached me during my protracted illness, it has remained unreviewed until now.

I started the disc with the Konzertstuck of Weber since, despite its naive "program", it is still one of my favourite bits of kitch. It is, by the way, one of the first pieces to attempt to relate a story without the help of a spoken or acted script. The fact that I could hear the wonderful precision of the Cleveland under Szell once again in works I had never heard him conduct before added another temptation to my choice.

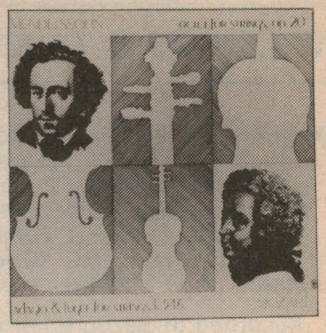
Casadesus' "Mozart" style is immediately recognisable in his staccato treatment of the first bars. And throughout the work, even in the most forceful of the romantic passages he preserves his usual refinement. Never a hint of self-indulgence for the sake of mere virtuosity. In this he is encouraged by Szell who had similar ideas on such matters. But despite this rapport between soloist and orchestra, nothing can cover the vulgarity of the march tune towards the end of the Liszt concerto. But before you get to this you will have had much compensation in the lovely sounds that precede it. To put it bluntly it is all grand fun.

The Liszt goes without a smudge on its cosmetic surface. All concerned are in top form and if you're looking for something to relax to, here it is. (J.R.)

☆ ☆ ☆

MENDELSSOHN OCTET

"... in excellent taste"



MENDELSSOHN: Octet for strings, op.20; MOZART: Adagio & Fugue for strings, K.546. Ensemble Instrumental de France. World Record Club stereo disc R 06056.

It is always a pleasure to hear rarely-played works. The Mendelssohn Octet, basically a double-string quartet, is an early piece, written for a family occasion; however, it is full of the things that the composer was to bring to fruition later on, tuneful, companionable and a delight throughout. The performance by this French ensemble is friendly and well-balanced — not perhaps as virtuoso as some others, but wholly acceptable and in excellent taste.

Mozart's fine work, in weightiness somewhat akin to the Masonic compositions, fares quite splendidly on this disc. The addition of a double-bass and adoption of a very slow pace make this music appear even graver than usual; some may wish for more mellowness and sweeter sound, but I am very satisfied with this reading. The recorded sound, in both works, is pleasant and clean and the disc is a good sampler of French string playing at its best. (P.F.)

SHOSTAKOVITCH — Suite from Music to Shakespeare's Hamlet. Music from the film New Babylon. Moscow Philharmonic Orchestra conducted by Gennady Rozhdestvensky. World Record Club Stereo Disc R 06071.

This is the incidental music composed for a nearly silent film version of Hamlet (1931) and not for the very much later film production of 1964. Although still young, the composer had already distinguished himself in many ways by other compositions and was, even then, no stranger to the musical theatre. He already had behind him two symphonies (the first an instant success all over the Western world), an opera ("The Nose"), still used as a fill in two-opera programs, and the ballets "The Golden Age" and "The Bolt". So he was no tyro when he got around to this music to Hamlet.

It has many moving moments, not the least at the very beginning where the Intro and Night Watch hint at the coming of the ghost of Hamlet's father. There follows a Funeral March, fine in its way, although no indication is given in the sleeve notes as to whom it is for.

There is a Fanfare and Dance Music, though where that comes in the play must remain a mystery. There is a Galop, real film music of the silent kind and an obviously popular Dance. Altogether there are 13 pieces, most of them brief, some of them woefully commonplace, some with pretty little tunes, a delicious lullaby, a Requiem starting with the Plainsong Dies Irae. Here and there are fragments perhaps deliberately reminiscent of other composers.

Yet the music has its own particular charm and can take its place with dignity with other music commissioned in the silent film days. The music for the film "New Babylon" was composed for a film dedicated to the 50th anniversary of the fall of Paris during the Franco-Prussian War and the succeeding Commune.

The titles of some of the items should give readers an idea of the music: The Siege of Paris, Operetta, Paris Stood for Centuries, Versailles, and so on. Not an unexpected contribution from a communist composer. There are quotations from Second Empire composers — to show the frivolity of the times — including a complex but very attractive waltz. Shostakovitch's technique is always dazzling, his illustrations though graphic make attractive hearing.

The playing by the Moscow Philharmonic always superlatively good and the sound is excellent. There is much irony in the music, not the Mahlerian kind that influenced the composer so much later in his life, but more like that of Les Six and sometimes even more like Walton in his Facade Suite.

Here and there is typical Shostakovitch cheekiness and vulgarity which I always find enjoyable and I consider the whole production well worth owning. (J.R.)

The ballet music of "Spartacus"

KHATCHATURIAN — Music for the Ballets Spartacus and Gayeneh. Vienna Philharmonic Orchestra conducted by the composer. World Record Club Stereo R 02401.

I have never thought much of the Gayneh music, which I reviewed in full a very long time ago. It was issued in its present form back in 1963. It may be suitable to the ballet it was composed to accompany but, otherwise, I have found it without merit. The reason I asked for this disc for review is because I always enjoy the slow movement of the other ballet, Spartacus — still in the Australian Ballet Company's repertoire. By the way, I hear it as background music to one of my very few TV favourites "The Onedin Line". It is, to me at any rate, a noble theme, out of context in the TV show but which none the less manages to fit in very well indeed.

On this disc it is admirably played despite a few jagged moments in the first item of the suite. Otherwise the playing in both pieces is excellent. So too is the sound. There is also a grand gradual crescendo at the end to celebrate Spartacus' victory that carries one irresistably with it. The music of Spartacus offered here is not of the scrappy incidental type but is made up of four not inconsiderable pieces. But don't say I didn't warn you about Gayneh. It starts with the notorious Sabre Dance. Surely I need say no more. (J.R.)

MOZART: Il Re Pastore, K.208. Edith Mathis, Arleen Auger, Sona Ghazarian, sopranos; Peter Schreier, Werner Krenn, tenors; Mozarteum Orchestra, Salzburg; conducted by Leopold Hager. DG (three boxed stereo discs) 2709 093.

Recorded in Salzburg last year, with assistance from Austrian Radio and BASF, this set gives permanence to a first-rate performance of Mozart's early opera seria, the title of which best translates as "The Shepherd-King". The recorded sound is simply splendid and there is a lovely illusion of spaciousness about it all. The Salzburg strings, in particular, have a silken shimmer; all the soloists are chosen for being regarded as Mozart-specialists and they prove to be quite outstandingly good. My greatest delight was in listening to Edith Mathis — I had not heard her to such advantage since first encountering her as Cherubino in Salzburg in 1966.

Truly, it would be difficult to have anything but praise for this set, with its accompanying libretto and essays, on purely musical and artistic grounds. I am, however, obliged to take issue with the manufacturers. The booklet claims this recording to be "the first complete performance of the work since 1775" and that is simply nonsense. Not only have there been other performances, but the recording is not a first either: RCA issued a boxed set in 1967; the singers then were Reri Grist, Lucia Popp, Arlene Saunders, Nicola Monti and Luigi Alva; the Orchestra of Naples took part and the work was conducted by Denis Vaughan. It was a far from negligible event, even if the Italian strings and the sound of a decade ago are less luscious than those provided by DG; moreover, the RCA set provided its 121 minutes of music on four sides, while DG requires six sides for 117 minutes! (P.F.)

☆ ☆ ☆

MENDELSSOHN: Incidental Music to "A Midsummer Night's Dream"; Judith Blegen, soprano; Frederica von Stade, mezzo-soprano; Philadelphia Orchestra; conducted by Eugene Ormandy. RCA Red Seal stereo disc ARL 1-2084.

This is an utterly enchanting performance of Mendelssohn's old warhorse. I guess there are many listeners, similar to myself, who think of Shakespeare's great comedy in purely theatrical terms, giving its many disparate elements equal value; this is very fair and proper and should, no doubt, be the attitude of anyone directing the play or taking part in its staging. Mendelssohn's view was a little different; his interest lay mainly in the fairy-tale aspect and to him (as to youthful audiences the world over) the heart of the play was Titania with her fairies; a little further along came Puck — Oberon, Theseus, the Athenian lovers and the "mechanicals" were of much lesser importance.

It isn't really so very strange that an old man (Ormandy was 78 when he made this recording in 1977) should come closest to a child's perceptions. Whether or not that is the reason, I know of no other performance of this score that approaches fairy-land more successfully. Ormandy is helped by

New devotional releases

BRINGING THE MESSAGE. Messenger. Light LS 5738. (From Word Records Aust, 18-26 Canterbury Rd, Heathmont 3135).

"Messenger" is three California based musicians, Rick Riso, Si Simonson and Mike Feller, together with backing artists. They combine here to produce a great sound, ranging from fairly solid rock to gentle ballad.

The titles: Bringin' The Message — Our Love Will Grow — Livin' In Love — Pressin' On — Song In The Night — Changin' Me — All You Need — I Still Love You — Now Is The Time — Home To You.

The quality is excellent, with a tight, clean bass, making it an album to enjoy and learn from again and again. (N.J.M.)

THE HEAVENS SING PRAISES. Word WST 9577. (Word Records Aust, 18-26 Canterbury Rd, Heathmont 3135).

With 200 voices, a Salvation Army Band, piano and organ working in delightful harmony, there can only be one result — musical pleasure. There are 10 tracks in all:

The Heavens Sing Praises — Songs Of The Beautiful — All All Is Well — Balm In Gilead — Behold Him — Yes He Did — Come To Me — Never Give Up — O Love Of Calvary — We Shall Rise.

The recording venue was the "new" (1936, 1961) Cathedral Church Of The Holy Spirit, Guildford, Surrey. With a nave over 300 feet long, there is plenty of space to create a beautiful ambience. The chorus of 200 was made up from 32 choirs in the London area. (N.J.M.)

☆ ☆ ☆

DAVID MEECE. Everybody Needs a Little Help. MYRRH MSB6619. (From Word Records Aust, 18-26 Canterbury Rd, Heathmont 3135).

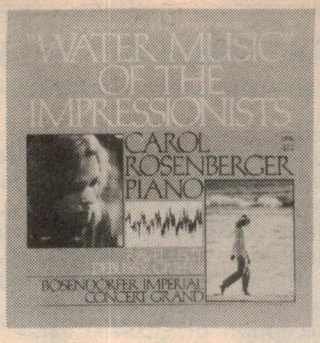
My only critical comment about this album is the somewhat trendy use of falsetto style of voice on some tracks; this may not worry you so have a listen anyway.

There are 10 tracks, with the lyrics on the sleeve liner: I Can't Believe It's True — God Holds The Future — Never Gonna Serve Anyone Else — Everybody Needs A Little Help — All The Time — Love Is The Reason — All I Can Do — Sunshine Jesus — Oh So Wonderful — He'll Take Good Care Of You.

The Backing Musicians do an excellent job, helping to make an album to enjoy — provided you're not allergic to falsetto! (N.J.M.)

Digital from Delos . . .

"VERY WIDE APPEAL"



WATER MUSIC OF THE IMPRESSIONISTS. Carol Rosenberger playing the Bosendorfer Imperial Concert Grand. Digital master stereo, Delos DMS-3006. [From P. C. Stereo, PO Box 272, Mt Gravatt, Qld 4122. Tel (07) 343 1612].

The New York Times remark about Carol Rosenberger's performance is quoted as "Ravishing, elegant pianism" – and I would not have the slightest reason to argue with that tribute.

As the title suggests, the music is all about sparkling water and the dominant sound is one of cascading arpeggios: LISZT: Les Jeux d'eaux a la Villa d'Este. GRIFFES: The Fountain of the Acqua Paola. RAVEL: Jeax d'eau, Ondine. DEBUSSY: La Cathedrale engloutie, Jardins sous la pluie, Reflets dans l'eau, Poissons d'or, Ondine.

Generous notes in the imported double-fold album talk about the recording, the artist and the music but you won't need the notes to enjoy nearly 48 minutes of cascading sound on a piano that combines a delightfully clean treble with bass all the way down to 16ft. It is music with a very wide appeal.

The recording itself confirms my impression of the Delos digital approach. Without deliberately exploiting the spectacular, they go for clean faithful sound – and that is what you get here. The surface is so quiet that you literally wonder whether the cartridge has been lowered into the groove. From there on, the dynamics are simply what the music demands. Recommended. (W.N.W.)

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superb orchestral playing, by excellent recording acoustics and balance and, in particular, by a very subtly edited performing score which includes many charming little incidentals usually omitted in other than complete versions. The singing ladies are in good form, the Nocturne is wholly mysterious and the Finale fades away in the best possible shivery manner. Top marks! (P.F.)

☆ ☆ ☆

BEETHOVEN: Piano Concerto No. 5 in E flat major, op.73 ("Emperor"); Artur Rubinstein, piano; London Philharmonic Orchestra; conducted by Daniel Barenboim. RCA Red Seal stereo disc ARL 1-1420.

There are so many first-rate recordings of the "Emperor" available nowadays (and this one is yet another very good one, needless to say) that one really feels entitled to apply very high critical standards. By those, this latest recording to be issued onto a groaning market, may well be classed as an oddity, even an eccentricity.

Back in 1969, many an eyebrow was raised when HMV issued an Emperor recording made by that brash young pianist, Barenboim and conducted by the stolid Klemperer, who was regarded as an arch-conservative. Though it seemed highly unlikely that these two musicians could possibly agree on anything, the result was quite exhilarating; the combination worked. Klemperer was, at the time of recording, 84 years old; Barenboim was 27! Seven years later, the still youthful Barenboim functions as conductor and accompanist to Rubinstein at the age of 88 and Rubinstein, even then, was still very youthful in many of his pianistic ideas. A very romantic pianist, accompanied by an equally romantic conductor! Surely, that should work?

It is sad to relate, but it did not work; for one thing, Barenboim seems to have leant over backwards to eschew all romanticism. His tempi are dead-slow, his phrasings absolutely correct and uninteresting; yet, I'm not sure that he is to blame. I suspect that the basic failure of this recording is caused by Rubinstein's great age, by allowances being made for him; this may be very proper, but it does not help the music! Rubinstein previously recorded the Emperor in 1964, also for RCA, with Eric Leinsdorf conducting; that performance took a full five minutes less than the one under review even though it was certainly not too fast. This disc is probably worth hearing as a curiosity, but it is not fair to Beethoven or to the memory of a great artist, finally forced into retirement by old age. (P.F.)

☆ ☆ ☆

BACH: Wedding Cantata, BWV 202; Cantata "Ich bin mir vergnugt", BWV 204. Edith Mathis, soprano; Kammerorchester, Berlin; directed by Peter Schreier. Archiv stereo disc 2533 363.

Bach's 24 secular cantatas vary greatly in style, musical content and weight; the two on this disc are traditionally purist in using only one voice and very restricted instrumentation. In the "Wedding Cantata", presumed to have been commissioned by a middling-wealthy citizen of Kothen or Leipzig, is scored for solo soprano, oboe and

RECORDS & TAPES — continued

violin, accompanied by two violins, viola and continuo; Cantata No. 204 adds a solo flute to the above, the continuo being provided by bassoon, cello, double bass and harpsichord.

These are by no means much-heard works; the secular Cantatas, with the exception of "Coffee" and "Peasant" which lend themselves to dramatic staging, are little known. In part, at least, this is caused by the enormous demands they make on performers. On this occasion, all those involved acquit themselves splendidly. Miss Mathis, forced to sing at the top of her range for much of the time, sacrifices some clarity of diction in a few of the arias; however, she sings quite splendidly and is brilliantly supported by the other soloists and the ensemble. Peter Schreier, in his new role of director, is firmly in control and allows no hint of any stylistic lapse. Last, but far from least, there is a splendidly improvised figured bass; the recording was made in Berlin's Christus-Kirche three years ago and the sound is clean, clear and delightful. (P.F.)

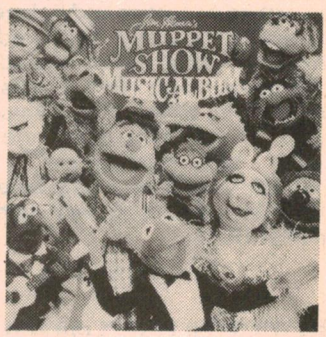
☆ ☆ ☆

SING WE AT PLEASURE. The Metropolitan Opera Madrigal Singers. Stereo. Telarc 5018. [From P. C. Stereo, PO Box 272, Mt Gravatt, Qld 4122. Tel (07) 343 1612].

"Sing We At Pleasure" (Thoas Weekles) is an apt title track for this album, reflecting the fact that the artists represented – four men and two women – give themselves over to madrigal concerts and recordings, as a diversion from their regular commitments to the MET. In itself, this is sufficient commendation, although notes on the artists and their activities appear on the jacket.

There are helpful notes also on the tracks but it would require more than the space available here to identify them in a meaningful way. Sufficient to say that many of the madrigals date back to the 15th and

The Muppets on record



MUPPET SHOW MUSIC ALBUM. Stereo. Astor SPLP-1580. (Also on cassette).

There can surely be few people in this country who need any introduction to Jim Henson's Muppets, launched on to world television screens by Britain's ATV network.

On this album you get 20 tracks of typical Muppet music (?). It begins and ends with the familiar theme and takes in tracks like the following: Hawaiian War Chant (The Pigs) – Rhyming Song (Fozzie Bear & Co) – Blue Skies (Prairie Dogs) – Eight Little Notes (Rowlf) – Da Wah Diddy Diddy (Geri and the Atrics) – Jamboree (Gonzo) – Henrietta's Wedding (Jerry & Lou) – Jam (Dr Teeth & Co) – Magic Garden (Kermit).

So it continues through side two with appearances (of course) by Miss Piggy, and an amusing "It Was A Very Good Year" by old-timers Statler & Waldorf.

The jacket is a group portrait and the sound quality is excellent but I warn of one thing: the album is intended for devotees who can supply their own visuals. Others will simply wonder what it's all about. (W.N.W.)

16th centuries, of English, French and Spanish derivation. Moving forward in time, America is represented by Stephen Foster and Douglas Townsend and the album concludes with a touch of contemporary Japanese.

The MOMS (Metropolitan Opera Madrigal Singers) admit that the items owe as much to chance and whim as to systematic planning – hence the title. As such, its appeal will be to those who share their interest in the madrigal form.

Although on the imported Telarc label, this is not one of their digitally sourced (and expensive) releases. But the sound quality is normal and perfectly adequate for the content and it won't cost you the earth. (W.N.W.)

☆ ☆ ☆

TOP PRIORITY. Rory Gallagher. Chrysalis L 36978. Festival release.

Rory Gallagher will continue to provide enjoyment to fans with this latest offering.

In true Gallagher style, he combines a fusion of blues and rock on all tracks; displaying his guitar playing talent with dazzling solo's, complemented by tight band backup.

The nine tracks on the album are: Follow Me – Philby – Wayward Child – Keychain – At The Depot – Bad Penny – Just Hit Town – Off The Handle – Public Enemy No. 1. (D.H.)

☆ ☆ ☆

GIRLS GO WILD. The Fabulous Thunderbirds. Chrysalis L 37099. Festival release.

"Girls Go Wild" is the debut album for a new American blues group called "The Fabulous Thunderbirds". The group comprises of four males: Kim Wilson: vocals and harmonica; Jimmy Vaughan: guitar; Keith Ferguson: bass; and Mike Buck: drums.

The 11 songs on this album are: Wait On Time – Scratch My Back – Rich Woman – Full-Time Lover – Pocket Rocket – She's Tuff – Marked Deck – Walkin' To My Baby – Rock With Me – C-Boy's Blues – Let Me In.

The Fabulous Thunderbirds are helping to rekindle interest in the blues, and this album with its clear vocals and precise musical arrangements will help the group even further. Blues followers should have a listen to this album. (D.H.)

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YES! Your response to our Mad March Mailer was so encouraging we've decided to keep our March Madness prices going right through June! And we've even thrown in an extra special just to make life interesting!

Hop in for your new Yaesu soon: you'd be a bunny to miss out!

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FT-227RB 2 metre with memorizer	D-2891	$445.00	$319.00	$126.00!!
CPU-2500RK CPU cont. 2m rig	D-2889	$575.00	$549.00	$26.00!!!
FT-7B HF mobile transceiver	D-2868	$649.00	$599.00	$50.00!!!
FL-2100B 1.2kW HF linear amp	D-2546	$599.00	$529.00	$70.00!!!
FC-901 antenna coupler	D-2855	$289.00	$265.00	$24.00!!!
DC/DC converter for 101Z/901	D-2856	$75.00	$69.00	$6.00!!!
Fan for 101Z	D-2865	$39.00	$29.50	$9.50!!!
YC-500S 500MHz freq. counter	D-2892	$499.00	$475.00	$24.00!!!
FTV-250 transverter	D-2894	$339.00	$299.00	$40.00!!!
FRG-7 communications recvr	D-2850	$395.00	$319.00	$76.00!!!
FRG-7000 digital comm. recvr.	D-2848	$695.00	$599.00	$96.00!!!

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We'll send any of these transceivers anywhere in Australia for just $6.00 extra by road freight: that's below cost. Take advantage of this offer soon!

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$695.00

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	30 Grose Street,	PARRAMATTA	Ph 683 1133
	263 Keira Street,	WOLLONGONG.	Ph 28 3800
	613 Princes Highway,	BLAKEHURST	(Opening Soon)
VIC	399 Lonsdale Street,	MELBOURNE.	Ph 67 9834
	656 Bridge Road,	RICHMOND.	Ph 428 1614
QLD	166 Logan Road,	BURANDA.	Ph 391 6233
	842 Gympie Road,	CHERMSIDE.	Ph 59 6970
ACT	96 Gladstone Street,	FYSHWICK.	Ph 80 4944
SA	60 Wright Street.	ADELAIDE.	Ph 212 1962
WA	414 William Street,	PERTH.	Ph 328 6944

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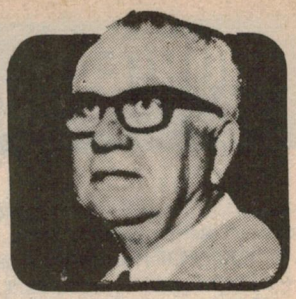
AMATEUR RADIO



by Pierce Healy, VK2APQ

DX hunting, DX awards, & DX-peditions — worthwhile wintertime projects.

News to hand this month was almost entirely devoted to the above subjects, which sparked the thought for a possible wintertime project — intensified lookout for rare or unusual contacts.

Unfortunately, most DX-peditions will have come and gone by the time these notes appear. However, there is a keen interest in awards, particularly among those who have recently attained amateur status and are active on the HF bands. Here are details of some overseas awards and dates of contests that may offer a real challenge. It also appears that the new Australian call sign suffix commencing with "D," "N" or "V" has an attraction for many operators from relatively rare DX or sparsely amateur populated countries.

WORKED ALL TRANSKEI AWARD: The Transkei Amateur Radio League has recently introduced this award. Stations outside zone 38 are required to have worked two "S8" stations since October 26, 1976. All bands, all modes, or mode combinations are permitted.

Applications should be sent to: The Transkei Amateur Radio League, PO Box 750, Umtata, Republic of Transkei (Africa). The application must be accompanied by a certified log extract, verified by two other amateurs, and 10 IRCs.

II GUIDE DOG AWARD: The Union of Radioaficinonados Minusvalidos Espanoles (URME), in co-operation with the UREs Vigo division, announces the "II Guide Dog Award" for operation from 0000GMT Monday June 2, 1980 to 2400GMT Friday June 6, 1980. Points will be for HF phone contacts with URME members, designated by their organisation who will use the phrase "perro guia" (guide dog). Each QSO with an official station will count one point. There will be a station with a special call sign worth two points.

Rules and list of prizes are available from Union de Radioaficionados Espanoles, Delegation Local de Vigo, Apartado No. 742, Vigo, Pontevedra, Spain. (Suggest enquire about rules from contacts made and send logs to above address.)

WORKED ALL STATES — YL (WAS-YL): This USA award is available for contacts made with an amateur YL in each state. Contacts may be over a period of years on any band or mode.

Full details may be obtained from the custodian of the WAS-YL award, Stella McPherson, WA4WPN, Elbow Road, Chesapeake, Virginia USA 23320.

MEXICO DX AWARD: This award is issued by the Mexico DX Club for contacts made with member stations. All amateurs outside zones 1 to 13 need to contact three different member stations.

Applications must contain details of the QSOs and 10 IRCs. Send to PO Box 21-167, Mexico 21, D.F. Mexico.

THE AMSTERDAM DX CERTIFICATE: Available for HF contacts with Amsterdam DX club members. Details from H. J. Klinjn, PO Box 9, 1000 AA Amsterdam, The Netherlands.

GUAM ISLAND AWARD: This award is sponsored by the Mariana Amateur Radio Club of Guam and is available to all amateurs who contact five different amateur stations on Guam. Contacts may be made on any band or mode. To apply send log information and five IRCs to Guam Awards Manager, PO Box 445, Agana, Guam 96910.

TEENAGE DX CONTEST: Sponsored by the Twin City Teenage DX Club (USA) held over the weekend June 7-8, 1980. All bands, CW and phone. Amateurs 21 years and younger sign /T and work anyone. Others work only those 21 and under. Exchange signal report and age.

ALL ASIA CONTEST: Held over weekend June21-22, 1980. See "AR" or "QST" for details.

There are also several awards sponsored by the Wireless Institute of Australia. Details of these are published in the WIA Australian Amateur Call Book.

The foregoing information is only a very small example. Throughout the amateur world there are hundreds of awards which are relatively unknown and can, therefore, be classified as rare. These often involve stations with limited or irregular operating periods.

It is surprising what a call or a mention during a DX contact can achieve — often an unexpected contact.

Of course it can be done more easily by joining a DX net operation, but achieving the same result under your own steam can be more rewarding. Try it.

TOWNSVILLE PACIFIC FESTIVAL CONTEST

This contest is promoted by the Townsville Amateur Radio Club in conjunction with the Townsville Pacific Festival organisers. The aim is to increase activity on all amateur bands by stations in Australia, New Zealand, Pacific Islands and countries bounding the Pacific Ocean.

DATE AND HOURS: 2200 GMT-1000GMT (8.00am-8.00pm EST) on the June 7-8, 1980.

SECTIONS: (a) Transmitting open, all bands. (b) Transmitting, above 50MHz. (c) Receiving, all bands.

BONUS POINTS: VK4 STATIONS — 1 point for contact with a Townsville station; 5 points for contact with VK4WIT.

BONUS POINTS: except VK4 stations — 9 points for contacts with Townsville stations; 15 points for contacts with VK4WIT.

BONUS POINTS: Overseas stations ex-

Radio clubs and other organisations, as well as individual amateur operators, are cordially invited to submit news and notes of their activities for inclusion in these columns. Photographs will be published when of sufficient general interest, and where space permits. All material should be sent to Pierce Healy at 69 Taylor Street, Bankstown 2200.

AMATEUR RADIO

cept ZL, P29: as for above plus 3 points for contact with any VK station.

BONUS POINTS: All stations; 160 metres – 5 bonus points per contact. RTTY & ATV – 10 bonus points per contact. CW/CW – double points.

VHF: (Above 50MHz); 0-50kM 1 point; 50-100km 2 points; above 100km 5 points.

CONTACTS: No cross band contacts; no repeater contacts; minimum of two hours between contacts per mode; standard RST and serial numbers to be used.

LOGS: To show the section entered and points claimed for each contact. For VHF contacts the distance in kilometres between stations must be noted, otherwise only one point per contact will be allowed. Standard declaration to be attached to front of log showing – name; address; call sign; section entered and points scored.

AWARDS: A perpetual trophy is held by the TARC and will be inscribed with the name of the operator with the highest score, who will receive a smaller trophy. Section winners will be awarded a certificate of merit issued by the Townsville Pacific Festival committee. Commemorative QSL Cards will be issued.

SEND LOGS TO: Contest Manager, TARC, PO Box 964, Townsville, Qld. 4810.

Closing date for entries – July 25, 1980.

HEARD ISLAND DX-PEDITION

Some conflicting comments have appeared in recent months regarding a DX-pedition to Heard Island during March, 1980. However, the only specific information is contained in a letter from Jim Smith, P29JS, which indicates that an expedition is planned for the summer of 1980-81. He advises that a Heard Island DX association has been formed, and gives details, some of which are as follows.

"The financing criteria for a 1980-1981 DX-pedition will be based on the following:

- Each member of the amateur team will be required to contribute to the expedition fund.
- Individual donations will be accepted.
- Offers of financial assistance from the various amateur radio societies, radio clubs and DX groups will be accepted.
- Disposal of residue of funds accrued after completion of QSL commitments.

"A considerable amount of research has been done and further work will be carried out relating to the necessary logistics to support an amateur DX-pedition to Heard Island.

"The Australian authorities have indicated that there will be no serious objection to a well planned amateur DX-pedition. It is intended that the team will consist of several experienced contest type operators.

"A trust account has been established by the founder members of the Heard Island DX Association to account for all funds received, and receipts will be issued for all contributions.

"In the unlikely event of the DX-pedition not taking place as scheduled, all donations will be either refunded, or allocated to another DX-pedition or worthy charity. In either event all donors will be notified personally.

"Firm offers of radio equipment have already been received, but no offers of ancillary equipment, antennas, power supplies, etc, have yet been solicited.

"Owing to weather conditions the time slot available is mid-December to mid-February."

The letter also pointed out that Heard Island is a rare DX country and amateur activity has not taken place from the island for 8 to 10 years.

Those interested should direct further enquiries to Jim Smith, P29JS, President Heard Island DX Association, PO Box 2053, Konedobu, Papua New Guinea.

WEEKEND CONVENTION

The South Australian, South-East Radio Group will hold its 16th Annual amateur radio convention over the Queen's Birthday holiday weekend in June, 1980.

This event is one of the oldest and most popular conventions held in Australia, with the number of amateurs participating increasing each year.

The venue is Mount Gambier, South Australia, and some of the activities arranged are:–

AMATEUR RADIO

● Saturday 14th June: registration, introductions. Dinner at a licenced club with family groups welcome.

● Sunday 15th June: trade displays, barbecue lunch, entertainment for the ladies and children. Competitions include scrambles on 7MHz, 21MHz, 28MHz, 50MHz and 144MHz bands. Hidden transmitter hunts on 3.5MHz, 28MHz and 144MHz bands. Prize presentation and tea will complete the day's events.

● Monday 16th June: inspection, with cheese and wine tasting, of Mount Gambier Co-op Dairy Products Ltd.

Further enquiries should be directed to: Convention Registrar, South-East Radio Group, PO Box 1103, Mount Gambier, SA 5290, or telephone Peter Decker, VK5ZBF (Bus) 087 25 6404, (AH) 087 25 1226.

INTERNATIONAL NEWS

The Japan Amateur Radio League has announced details of the 1980 Amateur Radio Festival to be held in the new hall of the International Trade Centre from the 22nd to 24th August, 1980. There were some 30,000 visitors to its 3rd Hamfest held in 1979 and more are expected this year. Further details are obtainable from JARL, Box 377, Tokyo Central 100-99 Japan. (WIA federal office).

RTTY NEWS

The Australian National Amateur Radio Teleprinter Society has been in operation for over three years and has a membership of nearly 600. The society provides technical information and parts kits for various pieces of RTTY equipment.

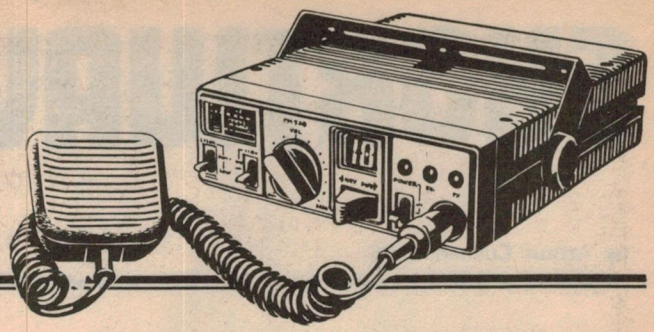
At the present time a technical committee is looking at the ASCII code, which the amateur service is now permitted to use. Some problems are apparent on HF bands, due to noise bursts, but this problem does not affect the VHF bands, 144MHz and above, even at higher speed.

An ANARTS news broadcast is made each Sunday at 0030GMT on 7045kHz, 14.90MHz and 146.6MHz and is repeated at 0930GMT on 3545 kHz and 146.6MHz. The speed is 45.5 bauds and 170Hz shift. VHF relays are also made in some other states.

Questions on the RTTY mode should be directed to PO Box 860, Crows Nest, NSW 2065.

Meetings are held on every second month at the Wireless Institute Centre, 14 Atchison Street, Crows Nest. At the April, 1980 meeting, Phil Bowes, VK1YS gave a very interesting and informative lecture on his home constructed computer.

The Australian CB SCENE



A NEW KIND OF "JAM" FACTORY FOR QUEENSLAND?

If your next attempt to communicate on 27MHz CB is blocked by unfamiliar hash, it could be due to a problem in a neighbouring power line. But then again, the source of the interference could be a small, sealed box, hanging unseen nearby. This by courtesy of a small company in Queensland!

For most CBers, the story had its beginning with a small advertisement in the "Telegraph" newspaper which read thus:

STOP TV INTERFERENCE
Irresponsible CB Radio operators can cause interference.
Stop this with our BUZZ-BLOKER
For literature write James Kennedy & Co, PO Box . . . etc.

I have no intention of aggravating the position by publishing the address, but one of the people who responded to the advertisement was Mr Ted Lyons of the Mt Coot-tha CB Club (Brisbane). He discovered that the "Buzz Blocker" (presumably the correct spelling) was a unit measuring 100 x 50 x 25mm and selling for $35.

The letter continued:

"Please find enclosed an illustrated pamphlet on the Buzz Blocker which is complete with battery lasting approximately three months and should be positioned as near as possible to your offending CB operators. You simply hang the blocker on a fence or in a bush at the nearest point to the CB.

The pamphlet which came with the letter read as follows:

Thank you for your enquiry regarding our "Buzz-Blokker". The reason for our developing the Blokker was to make it possible for a person who is having interference problems to send out a signal to indicate to an unknown user of CB radio equipment that his equipment is causing interference with the reception and use of other electronic devices in his immediate vicinity. By sending out a continuous heterodyning tone over the radio frequency spectrum from 26.965 to 27.235MHz it warns neighbouring CBers (in a radius of 100+ metres) that the person who is using the Blokker is suffering from Radio Frequency or TVI caused by the CB set. Under RB14 of the Wireless and Telegraphy Act, any CB operator who is informed that he is causing interference to radio and/or television reception must cease transmissions immediately. The "Buzz Blokker" can thus be used as a non-verbal way of reminding the CBer of his responsibilities under the Act.

The Minister for Post and Telecommunications, Mr A. A. Staley, has defined the "Buzz Blokker" as being a non message sending device and under the current Wireless and Telegraphy Act no licence is required for its operation.

One implication in the pamphlet is that a CBer must cease operating immediately he/she receives any kind of a complaint from anyone at all – even in the form of a non-verbal buzz from a hidden Bloker, Blocker or Blokker. Such is not the case.

P&T inspectors are delighted if CBers and adjacent residents can indeed resolve their problems amicably.

If they can't, then complaint must be directed to the P&T Department. They will investigate and determine what is best to be done: whether the CBer should be ordered off air protem or permanently; or allowed back on air on the grounds that the problem has solely to do with the complainant's equipment.

The idea that a CBer or amateur or anybody else should respond to a non-verbal interference style buzz is preposterous.

But I doubt that Mr Kennedy is in any position to moralise. He is proposing to "stop TV interference" by selling a device which itself generates interference and adds to pollution of the airwaves. Indeed, the leaflet nominates as distributors to NSW and Victoria a concern called "Jamco"!

As for the reference to the Minister, it is a fact of life that the Blocker, along with countless other sources of RF interference, are not transmitters within the meaning of the Act. It therefore does not require a licence and is actually outside his direct jurisdiction as the Act now stands. But it is unthinkable that the Minister would endorse the device.

Legalities aside, can you image the ramifications of TV viewers resorting to Buzz Blockers in a tense situation. The result could only be confrontation and chaos.

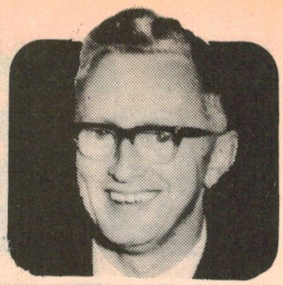
Many thanks go to Mrs Barics and Mr Lyons for the basic information this month. This column can only work as a national CB forum with your help. Let's make it a team effort. Your name can be mentioned or omitted, as you wish. My address: Mrs Jan Christensen, PO Box 406, Fortitude Valley, Queensland 4006.

Trouble on UHF

From Mrs Barics of Traralgon, Victoria, comes information about a large-scale "invasion" of the UHF CB band by the State Electricity Commission of Victoria. Refused a further allocation on VHF, the Commission has set up bases in the Warragul, Morwell, Moe and Traralgon districts, each involving 20 or more mobiles, operating in the UHF CB band. They started out on channel 29 but have since transferred to channel 20, following representations from Mrs Barics. The SEC say that UHF CB equipment is relatively inexpensive and that they have a perfect right to take out licences and operate in the CB band, along with other business users.

Come on, Mr Staley. Small business operators are one thing. Big commercial networks operating dozens of vehicles are quite another.

SHORTWAVE SCENE



by Arthur Cushen, MBE

Deutsche Welle tops shortwave poll

Every three years a survey of the popularity of international stations is conducted among shortwave listeners. This time, the honours go to Deutsche Welle, the Voice of Germany, which has taken over the top place for the first time.

The poll is conducted every three years by the International Shortwave Club of London and has now been a regular event for the past 15 years. During that time, there has been little change in the ranking of the leading stations. This year the Voice of Germany is in first place followed by the BBC World Service, Radio Nederland, Voice of America and Radio Australia in fifth place. In the past 15 years these stations generally have been fighting it out for top position, though in the first two surveys Radio Sweden was top.

The most consistent performer has been the BBC World Service which has taken second place in all the surveys. The Voice of Germany's move into top place reflects the increasing use of relay bases in Africa and the Caribbean. This is backed up by high powered transmitters in Germany which carry the programs from Cologne in over 30 languages to all parts of the world.

The official placing of the five most popular stations and their positions in the 1977 and 1974 surveys are as follows:

	1980	1977	1974
Deutsche Welle	1	4	5
BBC	2	2	2
Radio Nederland	3	1	1
Voice of America	4	3	3
Radio Australia	5	5	5

The actual votes polled for the survey this year were Voice of Germany 8695, BBC London 6872, Radio Nederland 5338, Voice of America 3079 and Radio Australia 2582. In recent surveys over 100 stations have been listed and this shows the wide variety of listening tastes of those who took part in the survey.

Notes from readers should be sent to Arthur Cushen, 212 Earn Street, Invercargill, NZ. All times are GMT. Add 8 hours for WAST, 10 hours for EAST and 12 hours for NZT.

US ROCK STATION

A new shortwave broadcaster should be in operation in the United States before the end of the year. Joseph Costello, owner of rock music station WRNO (FM) in New Orleans, has applied for a construction permit to build a shortwave station. The station would broadcast 25 minutes of rock music and 5 minutes of network news every half hour. Multi-national advertisers would be sought. A wide-angle antenna oriented towards Europe would be used and, if successful, a second service to Latin America would be undertaken.

Unlike the five private shortwave stations currently broadcasting from the United States, Costello's station would broadcast music and advertising rather than religious programming. Federal Communication Commission rules currently ban domestic shortwave broadcasting. Costello may in the future seek a rule change to lift the ban, although his current plan is apparently permitted under the rules.

DUBAI CONTINUES TESTING

Test transmissions from Dubai continue to be received on 21500kHz with a relay of the Arabic Home Service program 0600-1000GMT. According to Chris Martin, reporting in "DX Post of Adelaide," the transmitter is of 300kW and further tests are to be undertaken when new crystals arrive. Chief Engineer Harold Robin is anxious to receive reception reports on these test transmissions.

The medium-wave transmitter on 1481kHz has recently been increased in power to 1500kW and this is used between 1315 and 2100GMT when the station closes. Broadcasts earlier in the day are carried on a 750kW transmitter. This new installation uses six towers which carry an elaborate antenna array which gives it a directional pattern to the west. The address of the station is Radio & Colour Television Dubai, PO Box 1695, Dubai, United Arab Emirates.

HIGH MOSCOW FREQUENCIES

Although the sun spot count is declining and international stations are still active on the high frequency bands the Radio Moscow World Service has been noted on 29057kHz with the usual news bulletin in English at 0600GMT and popular music at 0630GMT. Another frequency, 29072kHz, has been heard with the Radio Moscow Home Service, also at 0600GMT, with the transmission in Russian. At 0700GMT, following the time pips, the "Mayak" network interval signal has been heard.

Radio Peking has been noted around 0700GMT on the even higher frequency of 30022kHz. The program was in Chinese and provides fair reception.

HIGHER POWER FOR BBC

The British Broadcasting Corporation has recently signed a contract with Marconi for the installation of four 500kW transmitters at one of the transmitting stations in Great Britain. In the past, the BBC has employed transmitters up to 50kW.

The four transmitters are scheduled to go into operation in 1983, and will cost around $A6 million. They are designed for unattended operation. Tuning information for up to 32 frequencies can be held in memory and changes of preselected frequencies made at any time in a few seconds.

RADIO VANUAATU

The New Hebrides is to become an independent country and this month is expected to change its name to Vanuaatu. The New Hebrides is a Condominium, and has been governed jointly by Britain and France since 1887. Earlier this year the New Hebrides Broadcasting Service changed its name to Radio Vanuaatu and has been using this slogan since early March.

The transmissions on 7260kHz give the best reception and the broadcasts include news in English at 0830GMT followed by French at 0845GMT. The balance of the program is in the local Bislama language, a type of pidgin English. The transmitting facilities at Vila have been upgraded, with transmissions observed on 1125kHz medium-wave and 3945 and 7260kHz short-wave.

SHORTWAVE SCENE

NEW SINGAPORE SERVICE

Radio Singapore recently changed its name to the Singapore Broadcasting Corporation and has introduced a new external service. The initial broadcasts were heard on 11790kHz with English at 0930 and French at 0945GMT. The signals suffered interference from the Voice of Indonesia at Jakarta which also uses this frequency. Singapore is now noted on 5052kHz at 1430GMT with English, while another channel, 5010kHz, also carries the same program. Recently another frequency, 4780kHz, has also been heard at this time.

Signals from Radio Singapore are also often received on the medium-wave frequency of 792kHz, with English at 1430GMT being the best time for reception. The power of the medium-wave transmitter is listed as 750kW.

KTWR DX SESSION

Plans are under way for a new DX Session from KTWR according to Gary Whitmore of the Continuity Department of KTWR Agana, Guam. The station is at present assessing the interest in such a project and is receiving DX publications so that they can become familiar with the type of information they could use in the broadcast.

Since this Trans-World Radio station commenced operation they have been finding difficulties in getting good clear frequencies for broadcasts to the Pacific and Asian area. The transmission to this area in English 0830-0930GMT on 11840kHz is providing fair reception. Other English transmissions are 0000-0130 on 17770 and 1430-1500 on 11940, 15350 or 15365kHz.

The address of the station is KTWR, Trans World Radio, Box CC, Agana Guam, 96910.

RADIO PACIFIC DX SESSION

An hour long program for shortwave listeners has been broadcast over Radio Pacific since June of last year. This broadcast, on the medium-wave frequency of 1593kHz from Radio Pacific at Manakau City in Auckland, New Zealand, is heard widely through the South Pacific. The time of transmission is 1800GMT Saturday, equal to 6am in New Zealand on Sunday morning.

The transmission, of one hour, is possibly the longest regular DX session anywhere in the world, and includes information on stations being heard and replies to listeners questions. The program has a regular feature supplied by the New Zealand Radio DX League and listeners in Australia and New Zealand are able to hear the latest information on League activity in their part of the country.

The address of Radio Pacific is: Private Bag, Manakau City, Auckland, New Zealand.

LISTENING BRIEFS

EUROPE

BELGIUM: The English transmission to North America 0015-0100GMT has recently been heard on 15380kHz. This frequency suffered interference from the BBC relay station in Cyprus and, at the time of going to the press, was moved to 15385kHz. The signals from Brussels on 15385kHz are now received without interference but the alternative frequency, 15175kHz, still provides the best reception. Brussels also broadcast to Africa 1605-1650GMT on 6010 and 17730kHz.

HUNGARY: Broadcasts in English are now carried one hour earlier as Hungary is observing Summer Time. This means that the transmissions heard during our afternoons will now be 0300-0330 and 0400-0430 on 6110, 9585, 11910 and 15220kHz.

YUGOSLAVIA: Radio Yugoslavia at Belgrade has recently added a 15 minute session in Italian which is broadcast 2245-2300GMT. This has resulted in a change of time for other language transmissions and means that English is now broadcast 2215-2230GMT instead of 2200 as previously. The frequencies in use are 6100, 7240 and 9620kHz.

ASIA

INDONESIA: Signals from Radio Republik Indonesia stations on the lower frequencies continue to be well received and Mataram on 2492kHz has been noted with a relay of news from Jakarta at 1400GMT. The station at Dili in Timor on 3120kHz has been heard with news at 1400GMT – closing is at 1415GMT, one hour earlier than scheduled.

PHILIPPINES: The Far East Broadcasting Company in Manila is using 17805kHz for a program called "Good Morning From Manila." This transmission is noted at 0000GMT with news and popular music.

YEMEN: Radio Sanaa has confirmed a report with a letter in English for reception on the frequency of 4853 and heard at around 2000GMT. The verification is reported by Nobuaki Takahashi, Musashino-shi, reporting to DX Time on Radio Australia.

AMERICAS

ARGENTINA: Radio Splendid, using 11880kHz; has been heard from around 1000GMT according to Peter Bunn in Melbourne, reporting in Radio Australia's DX Time. The frequency is not heard as often as their other outlet, 5985kHz, which is generally a more reliable signal.

COLOMBIA: Radiodifusora Nacional de Colombia at Bogota, using 9635 and 11792kHz, has been heard opening at 0955GMT. The latter frequency gives the best reception.

NICARAGUA: Radio Zinica at Bluefields has been noted by Peter Bunn on 6120kHz with Spanish news items at 1145GMT. Radio Zinica was formerly known as Radio Atlantico, and has apparently recently boosted transmitter power on this frequency.

New Products

$199 oscilloscope from Dick Smith

Recently released by Dick Smith Electronics, this neatly styled little oscilloscope should be just the shot for the hobbyist who cannot afford an expensive CRO. Called the Q-1280, it features a 5MHz bandwidth, 10mV/division sensitivity, and four timebase ranges to 100kHz. The best part of all is the price — just $199, including sales tax!

Until recently, if you wanted a CRO you had to dig deep into your pocket and pay out big dollars. Consequently, most hobbyists have "made do" without this valuable item of test equipment, simply because they could not afford, or justify, the purchase price. Now, with the release of the $199 Q-1280, a CRO has been placed within the financial reach of most hobbyists.

The Q-1280 employs a nominal 75mm blue-tinted screen, although the effective viewing area is somewhat less than this figure suggests – around 65mm diameter in fact. Dimensions are a compact 202 × 160 × 305mm (W × H × D) including knobs and feet, while mass is 3.8kg.

Vertical deflection sensitivity is variable in three divide-by-ten ranges, with continuous 100× variation in each range available from the adjacent "vertical gain" knob. This allows the sensitivity to be varied from a specified maximum of 10mV/division to 100V/division. The maximum allowable input voltage is 600V peak-peak for less than one minute.

The divide-by-ten ranges were found to be accurate within ±5% and can be calibrated with trim controls beneath the CRO. It should be noted, however, that the CRO is not calibrated to a reference voltage and the volts/division calibration is dependent upon the actual sensitivity of the particular CRO. The review model featured a maximum sensitivity of 8mV/division, which is slightly better than the 10mV specified.

Four ranges are provided for the timebase in ×10 steps from 10Hz to 100kHz with a 1-100× magnification adjustment available by means of a "sweep variation" knob. In theory, this would allow a maximum sweep speed of approximately 1us/division if it were not for the fact that the horizontal amplifier is 3dB down at 500kHz.

The timebase can be calibrated by adjusting the horizontal gain adjustment trimmer located on the bottom of the instrument. Switching to other timebase ranges can result in variations of up to 10% from the calibrated sweep, however.

An attractive feature of the timebase switch is the ability to select X-Y operation, with the horizontal trace being the horizontal component. This makes Lissajous figure operation for comparison of two signals an easy matter. The gain of the horizontal amplifier in this mode is a claimed 500mV/division. We measured a somewhat better figure of 250mV/division.

Timebase triggering can be either internal or external, and is selected by a small slide switch. We found triggering on the internal mode sensitive to input frequency and voltage, with adjustment of the "sweep variation" and "vertical gain" controls usually necessary to display a stable triggered waveform.

Input signals to the vertical input can be either AC or DC coupled, while input impedance is a claimed 1M shunted by 35pF. We measured an input impedance of 950k, which is just within the 5% tolerance specified. AC bandwidth measured 2Hz to 6.5MHz (–3dB points) – figures which are quite adequate for the average hobbyist and in many other situations as well.

Additional features of this CRO are the DC balance, frequency compensation and the trace rotation adjustments. The focus and brightness controls are located at the rear of the CRO. No graticule lighting is provided, but this feature was not particularly missed. One feature we did miss, however, was a tilting bail to enable a more convenient viewing angle.

At $199, the Q-1280 should be within the financial reach of most hobbyists. Features include a 5MHz bandwidth and 10mV/division sensitivity.

Internal layout of the Q-1280 is clean and uncluttered. One very large PC board containing all the circuitry covers the entire base of the CRO and is screen printed for easy component identification. The transformer is mounted at an angle, presumably to reduce the hum field imp-

(continued on p97)

RARE ADDITIONS FROM MARANTZ WORTH READING ABOUT. AND LISTENING TO.

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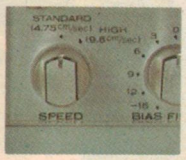
ST-500 AM/FM STEREO COMPUTUNER
features state-of-the-art electronic quartz-locked synthesized tuning with 14 station (7 AM, 7 FM) memory presets. AM tuning is particularly sensitive and, with more FM stations due in 1980, the ST-500 tuner is a sound investment for the future.

PM 700 INTEGRATED AMPLIFIER
features Dual 5-band Graphic Equalizers and delivers 70 watts True Power per channel into 8 ohms.

The current interest in high-definition moving coil cartridges makes the built-in moving coil head-amp on the PM 700 a particular plus. This model offers the most demanding audiophile a new concept in power, price and performance.

SD 8000 2-SPEED CASSETTE DECK
takes your system beyond the traditional limits of cassette deck technology. The Compudeck Feather-Touch control centre (inset left) offers superior programming capability, e.g. up to 19 selections in whatever order you wish. Two speeds give you the flexibility of true high-fidelity recording at 3-3/4 i.p.s. plus the economy of 1-7/8 i.p.s. when recording time is a factor. Also: Dolby Noise Reduction; digital display including clock and LED meters.



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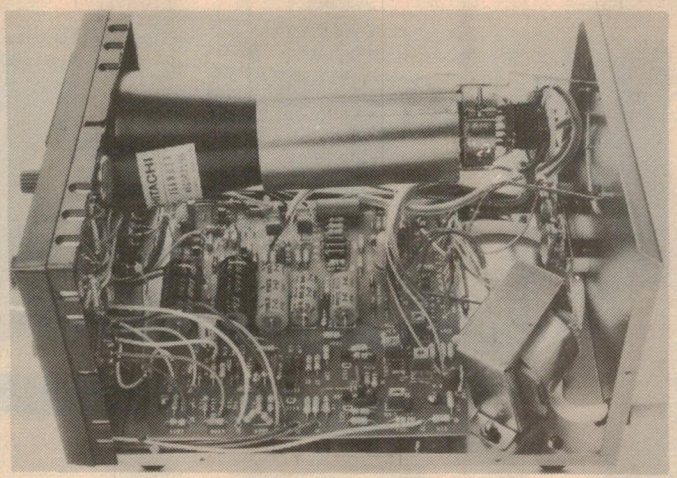
ADE

DEALER ENQUIRIES WELCOME

$199 Dick Smith CRO . . . ctd from p 96



Internal layout of the Q-1280 is clean and uncluttered, with all the circuitry on one large PC board.

inging upon the CRT. As a further precaution, a metal shield is included to protect the tube from stray magnetic fields.

With the minimal controls provided, the Q-1280 is an easy CRO to use. The trace is bright and sharp, the controls are well laid out, and the unit is compact, lightweight and portable. Our only real criticism concerns the noticeable power supply ripple impressed upon the trace at low sweep rates – a criticism which we're sure many will overlook in view of the low price.

A 20-page user's manual is supplied with the oscilloscope and provides notes on operating procedures, as well as a circuit diagram. Also supplied is a length of screened cable terminated with banana plugs and alligator clips to serve as probes.

Our overall impression of the Q-1280 oscilloscope is that it represents good value for money. The specifications may be modest, but this has been done to keep the price as low as possible. We're sure that its $199 price tag will attract many hobbyists who otherwise could not afford an oscilloscope.

Further information on the Q-1280 oscilloscope can be obtained from Dick Smith Electronics, PO Box 321, North Ryde, NSW 2113, and from all Dick Smith Electronics stores. (J.C.)

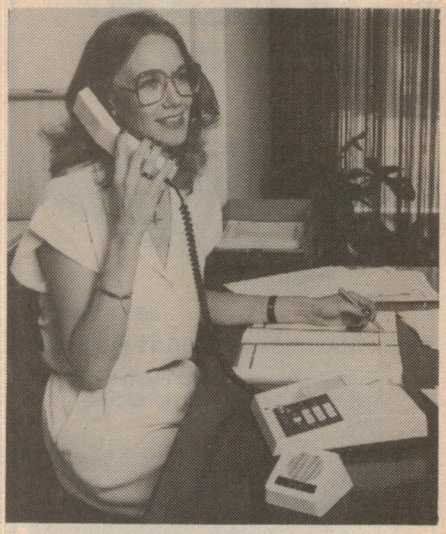
High brightness gas discharge displays

Two new series of planar gas discharge displays offering extremely high brightness have been announced by Beckman Instruments, Inc. The HB-330 and HB-350 series are designed for use where the need for greater brightness is imposed by viewing environments, as in automotive, avionics and instrumentation applications.

The Beckman high brightness displays use raised cathode technology and are designed for multiplex or pulsed DC operation, with or without suppressed (blanked) zeros. Brightness of up to 500 footlamberts can be achieved at one-third duty cycle. Viewing distance for the 14mm-high HB-350 series is 12m; for the 8mm-high HB-330 series 6m.

For further information contact Warburton Franki, 199 Parramatta Rd, Auburn, NSW 2144.

Pushbutton phone with memory



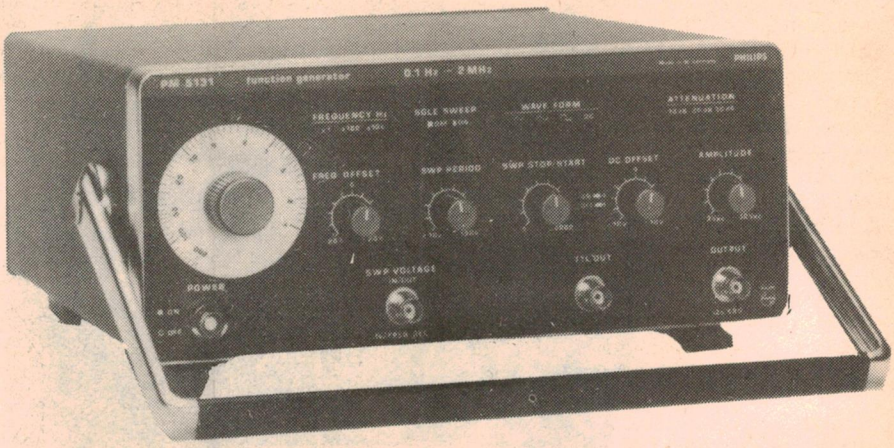
An Australian designed pushbutton, 50-number memory telephone has been approved by Telecom for the Australian market. It is claimed to be the only Telecom approved memory telephone which offers features such as PABX compatibility, loudspeaker operation and automatic re-dial.

Called the Speakeasy, the telephone contains a loudspeaker and microphone, allowing hand free operation. The automatic re-dial can be activated with one button to contact an engaged number on a continuing basis. The set is powered from a 240V supply, but will operate normally during the absence of mains power except for accessing numbers stored in the internal memory.

The Speakeasy is distributed by Systems Automation Micronic Pty Ltd, 31-33 Hume St, Crows Nest 2065.

New Products

Philips PM5131 Function Generator



A maximum output of 30V peak to peak and facilities for both internal and external sweep are two of the features of the PM 5131 Function Generator recently introduced by Philips Test and Measuring Instruments.

The generator provides sine, triangular and square waves in three logarithmic subranges from 0.1Hz to 2MHz. A frequency offset vernier allows settings to be varied from ±20%. Pushbutton selection is provided for the three waveforms as well as a separate choice of DC voltage.

A three-and-a-third decade internal sweep facility is provided with adjustable sweep range and period variable from 10 to 150s. This allows the whole 20Hz to 20kHz audio band to be covered in a single sweep, for example. External sweep is also possible either up or down the frequency range.

Continuously variable output attenuation is provided up to 20dB in addition to fixed attenuation in 10dB steps up to 60dB. The main output has a 50 ohm impedance and there is a separate TTL output.

Further information is available from Philips Test and Measuring Instruments, 25-27 Paul St, North Ryde, NSW, 2113.

Programmable scanning receiver

GFS Electronic Imports, Australian distributors for JIL, has announced the release of the Model SX-200 HF/VHF/UHF programmable scanning receiver.

The SX-200 is an AM/FM receiver capable of scanning frequency ranges of 26-88MHz, 108-180MHz and 380-514MHz. The receiver has the ability to accept upper and lower search limits, which allows any selected band to be searched.

Scanning speed can be varied and scan delay can be set to zero or four seconds. In addition, the instrument incorporates 16 non-volatile memory channels which may be either fully or partially scanned. A Fine Tuning control allows monitoring of signals

away from the standard frequencies. The receiver can be operated from 12V DC or 240V AC.

Additional information from GFS Electronic Imports, 15 McKeon Rd, Mitcham, Vic 3132.

Sound generation ICs from TI

Three new complex sound generation integrated circuits have been announced by Texas Instruments. Two of the circuits are complex sound generators that can be used separately or with a microprocessor-based system. The third circuit is a sound generation controller designed to provide low-cost, programmable tone and noise generation capability for microcomputer systems.

Noise, tone, low-frequency sounds, or a mix of these three, can be created to serve a wide range of requirements in arcade or home video games, toys, timers, alarms, industrial annunciator circuits or feedback controls. Both new circuits feature on-

board audio amplifiers which can drive an 8-ohm speaker with approximately 100mW of audio power.

The SN76487N and SN76488N are complex sound generators fabricated with integrated injection logic which allows both logic functions and linear audio circuitry to be combined on the same chip.

Both the SN76487N and SN76488N are TTL and MOS compatible. Programming via external components allows a wide range of sounds to be created including alarms, gun shots, explosions, bird calls, phasor blasts, and race cars.

The SN76489AN Sound Generation Controller is designed to interface with an 8- or a 16-bit microprocessor system. It is particularly well-suited to personal and home computer applications wherein the full range of complex musical chords and other sound effects can be programmed.

Further details may be obtained from Texas Instruments Australia Ltd, PO Box 106, North Ryde, NSW, 2113.

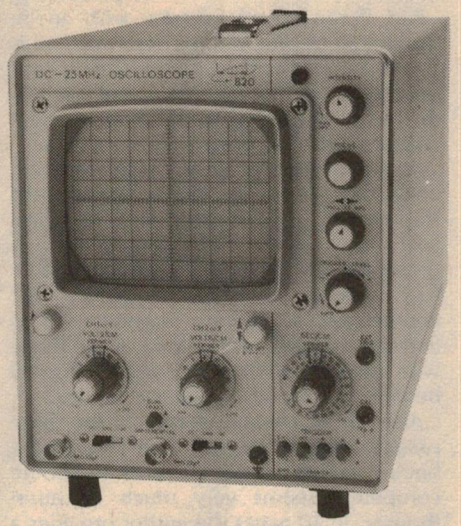
BWD 820 dual trace oscilloscope

BWD Electronics has released a new 25MHz oscilloscope, the BWD 820, which features instant changeover from dual trace to differential operation, and is designed with video servicing applications in mind.

The BWD 820 features a bandwidth of DC to 25MHz and sensitivity of 2mV/cm to 20V/cm. Timebase ranges are from 40ns/cm to 5s/cm, and the oscilloscope may be triggered by pulses up to 40MHz. Both attenuator and timebase controls incorporate continuously variable vernier settings.

High sensitivity amplifiers incorporated in the BWD 820 enable signal levels to be monitored from microphones, pickups or playback heads and traced right through the circuit under test. For video recorder servicing applications a VHF demodulator probe is available which allows the input and output RF signals to be monitored.

When switched to DC coupled X-Y-Z operation, the TTL compatible Z modulation input allows the BWD 820 to be used as a monitor for computer or digital



analyser outputs. In this role the rise time of less than 13ns and the high speed ECL trigger circuitry provides jitter free display of waveforms to over 40MHz.

Further details from BWD Electronics Pty Ltd, Miles St, Mulgrave, Vic 3170.

Universal dimmer & speed controller

The A&R Soanar Group has sought to meet an obvious need in homes and hobby workshops for a universal dimmer-cum-speed controller.

Wall mounted light dimmers are common, of course, as also are workshop type drill speed controllers. However, the new A&R product, marketed as the Arlec Speedright PC351, is styled for use around the home; even so, it is rated to cope with loads of up to 1000 watts and is fitted with a self-resetting thermal overload cutout.

It is intended to plug directly into a normal power point and has a matching 3-pin receptacle to take the appliance. A knurled knob, marked with an 0-10 scale allows the voltage to be varied continuously over a very wide range.

According to the manufacturers, the PC351 can be used for motor speed control (drills, polishers, blenders, fans, &c), for heat control (up to 1000W) and for lighting (eg incandescent reading lamps, etc). We tried it on a variety of appliances around

the home and it performed exactly as expected, without any hint of bother.

The Arlec PC351 is being handled by electrical dealers and hardware stores and carries a recommended retail price of $26.50.

Books & Literature

Computer Programming Made Simple

COMPUTER PROGRAMMING MADE SIMPLE, by J. Maynard. Second Edition. Soft covers, 346 pages, 215mm × 127mm, illustrated with photographs and diagrams. Published by W. H. Allen and Co Ltd. Price in the UK £2.50.

First published in 1972, the second edition of this title has been extensively updated, and now includes eight chapters on Basic and a summary of the main features of home computers, as well as introductory material and a comprehensive treatment of Cobol and Fortran. Each chapter concludes with a set of exercises, and each part of the book is followed by revision questions which allow the reader to assess his understanding of the concepts covered.

The author suggests that computer programming is surrounded by a "continuing but unnecessary mystique", and that the computer is basically a very simple device which can do "whatever we know how to order it to perform." Whether or not computer programming can really be made "simple", this book is a step in the right direction. Clearly written, with many useful examples, the book will be of interest to the hobbyist and to anyone concerned with computers, as well as being a good introductory textbook.

The first part of the book; "Introduction to Computer Systems" describes the basic components of large computer systems and contains useful explanations of operating systems, logic and flow-charting, and number systems. The second part is a comprehensive treatment of Cobol, an English-like programming language particularly suited to business data processing.

Part Three covers Fortran, with an introduction to time-sharing systems, and is somewhat briefer than the preceding part, but clear and comprehensive, and includes the usual exercises at the end of each chapter and a set of revision questions.

Part Four covers Basic, with separate chapters on the most important statements, on constants and variables, and on arrays. The information is presented in an easily understandable form, with sample programs for geometrical calculations. Beginners should find the material very helpful, while those with some experience of programming will be able to pick up helpful techniques.

After an excellent coverage of the three programming languages, Part Five of the book covering microprocessors and home computers seems very much an afterthought. In 10 pages the author provides a brief explanation of some of the more common terms (RAM, ROM etc), a cursory outline of a basic home computer system, and an introduction to the concept of bus structures. We felt that anyone interested enough to read to Part Five can be taken to be already familiar with the material presented.

In spite of this, we would recommend Computer Programming Made Simple. It covers three major programming languages in detail, giving the beginner an overview of the field, and allowing those with experience of one or the other languages to see for themselves the similarities between them, perhaps leading to a greater understanding of the language they work with.

Our review copy came direct from the publishers, but we understand that copies will be available from local technical booksellers.

2-Metre Handbook

TWO-METRE ANTENNA HANDBOOK, by F. C. Judd, G2BCX. Published 1980 by Newnes Technical Books. Soft covers, 157 pages 185mm × 120mm, illustrated with diagrams and pnotographs. Australian price $10.50.

This book contains five chapter headings, covering propagation, omnidirectional antennas, directional antennas, matching and cables, and antenna performance. Within these chapters is a lot of useful information, both theoretical and practical.

The author is a contributor of many years standing to RSGB and other amateur publications. He obviously has a great deal of practical experience behind him, plus access to equipment with which to test theoretical designs.

In view of this, it is unfortunate that the book contains a number of statements which, to say the least, were "off-putting" to this observer.

For example, describing his own "Slim Jim" antenna (page 27) he claims a radiation efficiency of 50% better than an (unspecified) ground plane antenna – an apparent 1.75dB advantage. But on page 28 he claims a gain of 6dB over a 5/8 ground plane. Why the inconsistency?

Could it be that the Author's conclusions about ground plane antennas were prejudiced by lack of precision in regard to the length of the radials: ". . . not less than 508mm but may be longer."

Again, the Author shows how "Slim Jim" was developed from the "J" matched end-fed dipole, but he stops short of explaining why making it into a folded dipole would do anything more than broaden its bandwidth.

There are other statements which are equally confusing. One, (pp 34, 54, 68) states that a finished antenna should be tested (for SWR) with the full length of feeder with which it is to be used. Quite apart from the fact that a long feeder can mask SWR, why is the length of feeder critical if the antenna can be adjusted to present a correct load?

Another (page 37) implies that a poor SWR can be due to a mismatch between the transmitter and the feeder. This is repeated in a theoretical discussion on pages 101 and 102.

It may well be that these are errors of presentation, rather than of basic concept, but they can still create misconceptions in the minds of readers.

These criticism aside, the book is still a very useful reference covering a wide range of aerial designs, data, tables, and practical constructional material.

Our review copy came from Butterworths Pty Ltd, 586 Pacific Highway, Chatswood, NSW, 2067. (P.G.W.)

Pascal Programming

INTRODUCTION TO PASCAL, by Jim Welsh and John Elder. Published by Prentice-Hall International, London 1979. Soft covers, 150mm x 226mm, 282pp. Price in Australia $13.95.

PASCAL was devised as a highly structured programming language in the late 1960s. Since then, Pascal has been enthusiastically adopted by universities and has experienced growing popularity both in commercial and home computing fields. PASCAL compilers and interpreters have already been written for a number of micros and when these become readily available PASCAL may start to replace BASIC as the standard language of micro systems.

The "Introduction to Pascal" is therefore a timely release and it should be essential reading to any computer enthusiast. It is also the only book we know of on Pascal that presents the topic in a clear and easy to understand manner. A large number of programming examples are used to demonstrate each feature of the language and actual program listings plus computer outputs are included.

The book starts with a simple discussion on the basics of writing a computer program. It then goes on to discuss type and variable declaration, simple input and output and then onto program control statements. For those unfamiliar with Pascal, line numbers are not used as in Basic or Fortran, but the program flow is controlled by control statements such as "repeat," "until," "for," "while," case of" and many others – this in part is why PASCAL is so easy to use and yet elegantly powerful.

In the following chapters one complete chapter is devoted to each of the following topics-procedures and functions, goto's, arrays, records, sets, files and pointers. The subject in each chapter is clearly defined in notation and terminology, its use explained plus any limitations or practical problems mentioned. As we mentioned there are numerous programming examples as well as complete computer listings.

In conclusion, an excellent book and one that is well suited to the computer enthusiast or computer science student. It is available from all Dick Smith Electronics stores. (R.deJ.)

World Radio, TV Handbook

WORLD RADIO, TV HANDBOOK, 1980, 34th Edition by Jens Frost. Stiff paper covers, 584 pages, 230mm × 145mm. Published by Billboard Ltd, London.

This book was reviewed by Arthur Coshen on page 102 of our May 1980 issue. We have been advised that it is on sale from McGills Newsagency, 187 Elizabeth St, Melbourne. Also from Technical Book and Magazine Co Pty Ltd, 289-299 Swanston St, Melbourne. The price quoted in each case is $16.95.

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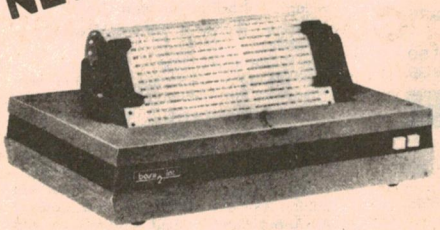
The new Pascal Computer System is driven by a unique 16-bit Pascal MICROENGINE™ — the first microprocessor hardware designed exclusively for direct high-level language execution. ☐ The processor is incorporated into a single board computer system, the WD/90, which directly executes Pascal intermediate code generated by the University of California at San Diego (UCSD) Pascal compiler, Release 111.0. ☐ Since P-code output by the Pascal compiler represents an ideal architecture for a computer executing Pascal programs and since the WD/90 directly executes P-code (no interpreter), these programs execute up to five or more times faster than equivalent systems.

The WD/90 Pascal MICROENGINE™ Computer includes: ☐ Pascal MICROENGINE™ processor ☐ 64K bytes of RAM Memory ☐ Two RS-232 asynchronous/synchronous ports (110-19.2K baud-full duplex) ☐ Two 8-bit parallel ports (500kHz maximum data rate) ☐ Floppy disk controller with direct memory access (DMA), switch selectable for: single or double density (IBM format); mini or standard floppy; 1 to 4 drives (same type) ☐ Floating point hardware (proposed IEEE standard) ☐ Memory Mapped I/O ☐ Enclosed power supply. Complete UCSD Pascal Operating System (Release 111.0)

LINE PRINTERS

NEW!

BASE 2



SPECIAL
$695
Inc options "S" & "T"
Usually
~~$895~~

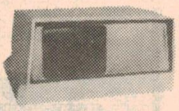
UNIT PRICING
standard MODEL 800 $695
option M $100
option S $100
option T $100
(By the time you read this, Base 2 will have commenced volume shipments of the MODEL 800. We regret that we cannot accept responsibility for any inconvenience this causes our competitors!)
SPECIFICATIONS
OPTIONS M 2K RAM buffer S high speed paper advance and graphics T tractor feed
PRINTING METHOD 7 Wire dot matrix bi-directional impact
PRINT AREA 8.0 inches (203mm)
THROUGHPUT SPEED 80 lines per minute
LINE SPACING 6 lines per inch
COLUMN CAPACITY 72 80 96 120 or 132 Switch or program selectable
CHARACTER HEIGHT .104 inches (2.65mm)
CHARACTER WIDTH .08 inches (2.0mm) at 80 cpi
PAPER WIDTH 9.5 inches maximum
RIBBON .5 inch (13mm) cartridge (5M chars)
INPUT/OUTPUT PROVISIONS (a) RS-232 (b) 20 ma current loop (c) IEEE — 488 type (d) Centronics parallel
SIZE 3 inches high (75.2mm) 10 inches deep (254mm) 14 inches wide (355.6mm)
WEIGHT 9 pounds (4.1kg)
OPERATING CONDITIONS 40 to 120°F (4.49C) 10 to 90% relative humidity
POWER 115 VAC or 230 VAC (switch select) 50 or 60Hz
EXTERNAL CONTROLS Power on-off self-test baud rate line buffer length 10 mode select
BAUD RATES Fifteen rates from 110 to 19,200
CHARACTER FONT 5 x 7 96 character ASCII
LINE BUFFER Two lines plus space for second character font

S100 BOARDS

- CPU CARDS
- MEMORY
- DISK CONTROLLER
- SERIAL & PARALLEL
- S100 FRONT PANEL

All quoted prices are exclusive of 15% sales tax.

YOU WORKED HARD TO BUILD YOUR COMPUTER SYSTEM. NOW!! WHY NOT PUT IT IN AN ATTRACTIVE FIBREGLASS CASE?



METAL BASE & FAN HOLDER

● Small	$49.95	● Small	$10.00
● Medium	$74.95	● Medium	$15.00
● Large	$99.95	● Large	$20.00

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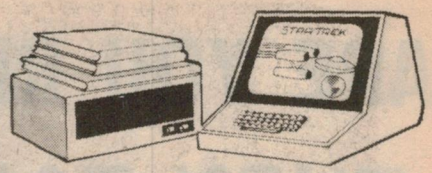
512 Bridge Rd, Richmond, 3121. (03) 429 5844
Franchise opportunities available.

Microcomputer News & Products

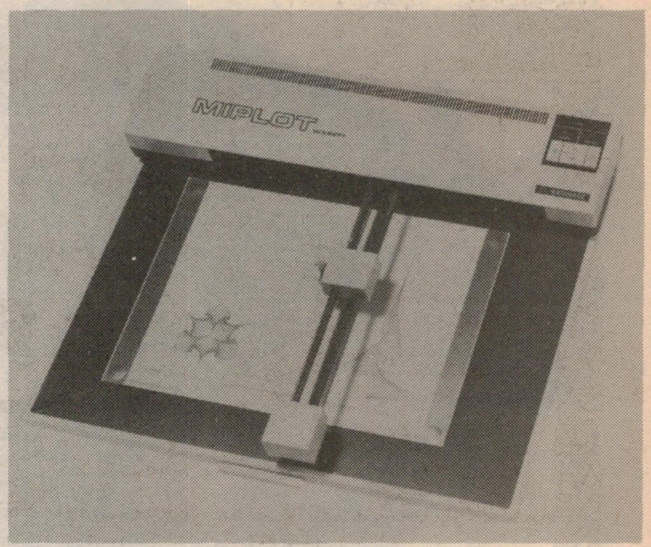


Mi Plot — an X-Y plotter for small computers

Two new X-Y plotters made by Watanabe Instruments Corp of Japan are now available through Jacoby Mitchell Pty Ltd. The WX4671 Mi Plot is of particular interest because it is intended for the personal computer market. Its price is $959, which is claimed to be about 25% of the cost of similar products. The WX4631 is more for the professional market, and is priced accordingly.

The Mi Plot accepts inputs in 7-bit parallel ASCII code and incorporates all the logic required for producing graphs and drawings using single character plotting commands. In addition the plotter has an internal character generator for alphanumeric characters and special graphics symbols, and can be used in the Printer mode to output character data directly. Characters can be enlarged up to 16 times, and can be rotated to four different orientations.

Maximum plotting area is 360mm x 260mm, and plotting speed is 50mm/sec, with a distance accuracy of 1%. Maintenance of the Mi Plot is assisted by a self test mode, which automatically draws a complete test pattern, and by the modular design of the electronic and mechanical assemblies.



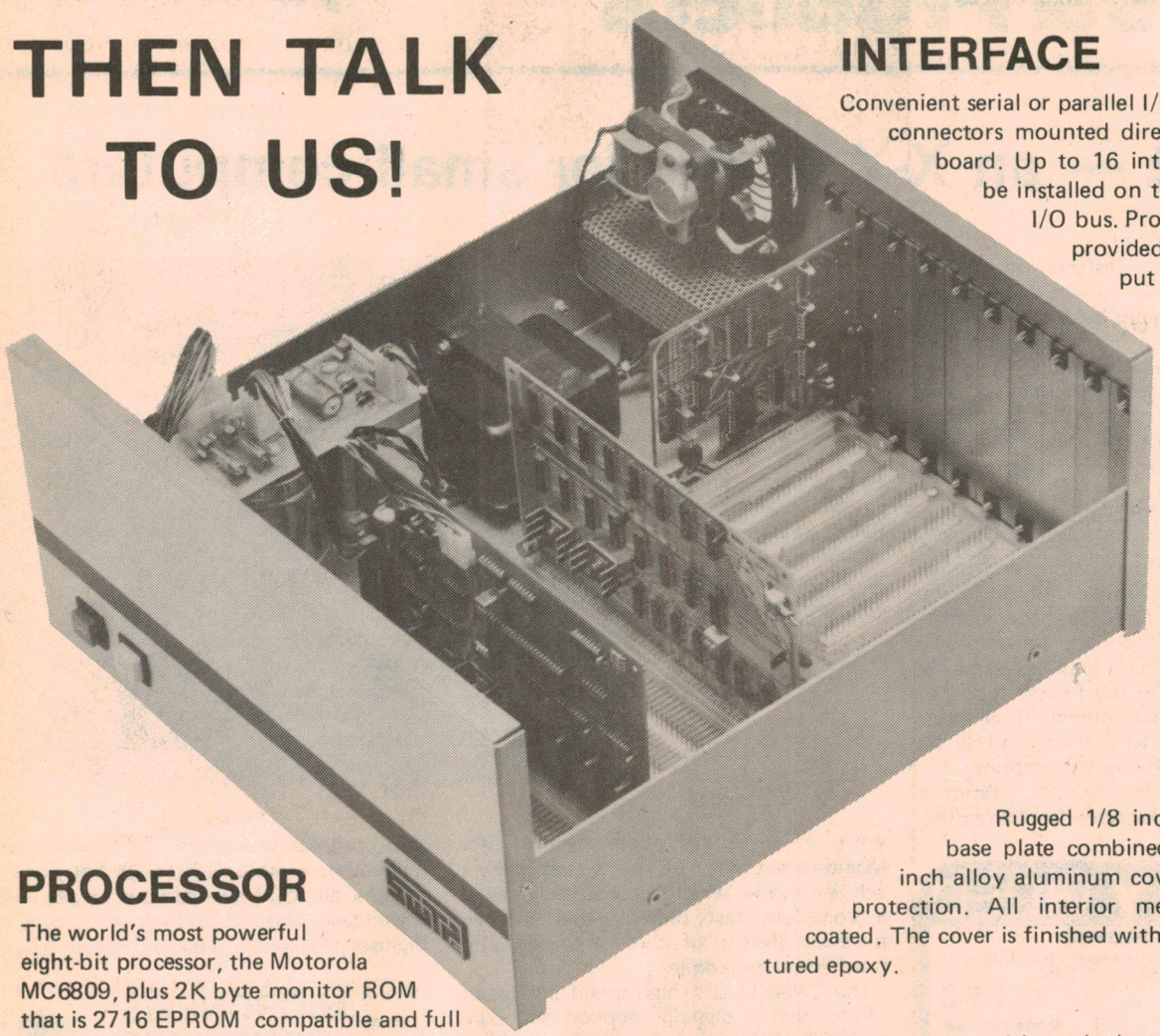
The Mi Plot can plot graphs, drawings, and ASCII characters, and simply connects to a printer output port of any microcomputer.

The WX4631 is a high-speed intelligent plotter that is digitally stepped and controlled by a built-in microprocessor. Plotting capability covers functions and alphanumeric characters, with the ability to print all ASCII characters in upper case and lower case. The WX4631 can also act as a digitiser that sends data and status to an

MICRONEWS CONTINUED

ARE YOU READY TO OWN A 6809

THEN TALK TO US!



INTERFACE

Convenient serial or parallel I/O cards have DB-25 connectors mounted directly on the circuit board. Up to 16 interface devices may be installed on the address decoded I/O bus. Programming strips are provided for input and output baud rate selection on each port. All outputs are fully buffered.

CABINET

Rugged 1/8 inch alloy aluminum base plate combined with a solid 1/8 inch alloy aluminum cover for unsurpassed protection. All interior metal is conversion coated. The cover is finished with a super tough textured epoxy.

PROCESSOR

The world's most powerful eight-bit processor, the Motorola MC6809, plus 2K byte monitor ROM that is 2716 EPROM compatible and full buffering on all output lines. Built-in multiuser capability, just add I/O cards to operate a multi-terminal system.

MEMORY— You can purchase the computer with either 8K bytes of RAM memory (expandable to 56K), or with the full 56K. The efficient, cool running dynamic memory used in this system is designed and manufactured for us by "Motorola Memory Systems Inc."

PERIPHERALS—The wide range of peripheral hardware that is supported by the 6809 includes: dot matrix printers (both 80 and 132 column), IBM Electronic 50 typewriter, daisy wheel printers, 5-inch floppy disk system, 8-inch floppy disk systems and a 16 megabyte hard disk.

SOFTWARE— The amount of software support available for the 6809 is incredible when you consider that it was first introduced in June, 1979. In addition to the FLEX9 operating system, we have a Text Editor, Mnemonic Assembler, Debug, Sort-Merge, BASIC, Extended BASIC, MultiUser BASIC, PASCAL and PILOT.

69/K Computer Kit with 8K bytes of memory ..... **$ 560**
69/A Assembled Computer with 8K bytes of memory ..... **$ 660**
69/56 Assembled Computer with 56K bytes of memory **$1660**

Prices + Sales Tax if Applicable *Prices Subject to Change Without Prior Notice.*

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Microcomputer News & Products

external controller. Twenty-seven built-in programmable functions are provided to simplify programming, and a 1600 byte buffer memory for storage of incoming data is standard.

Jacoby Mitchell Pty Ltd is now located at 13-15 Wentworth Avenue, Sydney 2010. They also have offices in Melbourne, Brisbane, Adelaide and Perth.

Pascal Business Programs

Six "S" Business Advisory Pty Ltd has released two new software packages written in Pascal UCSD and designed to be run on moderately priced microcomputer systems. 6S-2 General Payroll is a full payroll package, including multiple time-rates, additions/reductions, management reports, cheque writing and group certificate printing and is intended to be run on systems retailing for less than $5000 including a suitable printer.

The 6S-5 Medical Accounting package is a comprehensive system capable of all general accounting for one doctor or for a group practice of up to nine doctors. It provides for seven different patient categories, bulk-billing, and the production of comprehensive financial reports. This package is also intended to run on moderately priced systems which include a heavy duty printer and video terminal.

Six "S" Business Advisory welcomes OEM enquiries. They are located at 39 Gheringhap St, Geelong, Victoria 3220.

Retail Developments

● As part of its expansion plans Abacus Computer Store of Melbourne has decided to sell computer components and kits in addition to its range of computer systems. The store will continue to provide comprehensive support for home, hobbyist, and business computer users, and will now also handle the full range of Silicon Valley products – giving Melbourne a truly one-stop computer store.

Abacus Computer Store is located at 512 Bridge Rd, Richmond, Vic. 3121.

● Anderson Digital Equipment recently moved into new premises at 31 Kate St, Kedron, a Brisbane suburb. The new complex comprises a showroom, reception area, general office, a large workshop area, classroom and storerooms, and covers a total area of over 500 square metres. The workshop is fully equipped to repair to component level any product marketed by ADE, ensuring efficient after sales service to Queensland customers of ADE.

MICRONEWS CONTINUED ➡

Microcomputer News & Products

New Keyboards

Daneva Control Pty Ltd has advised that they now have in stock a new series of keyboards from General Instruments.

Initially, the series will consist of a 72 and a 70 key unit. The 72 key word processor format, C72 MWP, is to the IBM sculptured layout, with an additional 19 keys for user definition. The 70 key version is based on the traditional typewriter layout with three user defined keys and cursor controls. Both keyboards offer totally solid-state switching, four levels of ASCII encoding with the options of parallel or serial outputs with RS232C or current loop.

Further information from Daneva Control Pty Ltd, 70 Bay Rd, Sandringham, Victoria 3191.

PET Space Invaders in Melbourne

For many people the most visible application of the microprocessor is the popular arcade game Space Invaders. For those willing to run the risk of addiction to this game (and the risk is indeed high), Edible Electronics is including a Space Invaders program in a free package of programs with every 8K PET computer purchased. To top it off, the PET is being offered at a special low price.

Edible Electronics is making the special offer to highlight the formation of a Commodore User's group.

For further information contact Joel, at Edible Electronics, PO Box 1053 Richmond North, Vic. 3121.

Australian mini for US market

In April of this year an Australian designed and built general purpose minicomputer was installed in a United States engineering plant. The Spectrum-11 D, a floppy disk based computer designed and manufactured by D. D. Webster Electronics Pty Ltd of Bayswater, Victoria, was installed at Dynatron Inc in Connecticut. Dynatron manufactures energy conservation systems for both US and world markets.

The Spectrum will administer Dynatron's bookkeeping, using software created by another Australian company, Tritechnic Pty Ltd of South Yarra. The chief executives of the respective companies, Mr David Webster and Mr Ray Maloney, personally supervised the installation which they believe is the first Australian computing system to operate on a US business site.

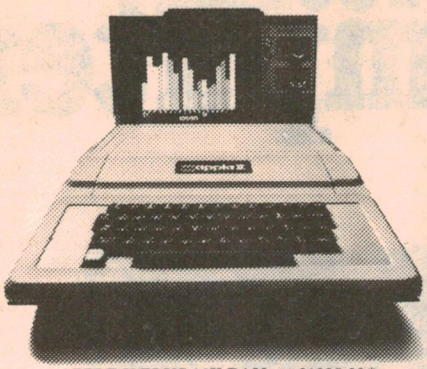
Following completion of the installation, Mr Webster and Mr Moloney took a second Spectrum-11 D to New York where they demonstrated their system at the Rockefeller Center from April 28 to May 2, 1980. The aim of the New York promotion was to find US distributors for the Spectrum and its associated software packages.

Wagga Computer Club

A group of personal computer enthusiasts in Wagga Wagga has recently formed the Wagga Wagga Computer Club for anyone in the area with an interest in non-commercial aspects of computing. Meetings are held at 7.30pm on the second Wednesday of each month in the offices of the State Emergency Services in Bayliss Street. Anyone interested in personal computing is welcome to attend a meeting, or to contact the Secretary, P. Yendle, at 4 Halloran Street, Wagga Wagga (069) 25 3146.

MICRONEWS CONTINUED

APPLE II/APPLE II PLUS COMPUTERS come complete with 12K ROM, Cassette Interface, 8 port I/O facilities, tutorial manual, language reference manual, system and hardware reference manual, introductory software manual, leads, connectors, games paddles and introductory software.



APPLE II PLUS 16K RAM . . . $1395.00 *
APPLE II PLUS 32K RAM . . . $1503.00 *
APPLE II PLUS 48K RAM . . . $1611.00 *

There's never been a better time to buy an Apple® II.

apple pascal

The lowest priced, highest powered Pascal system on the market.

Our high-level, full feature Language System consists of a plug-in 16K RAM language card, five diskettes containing Pascal as well as Integer BASIC and Applesoft extended BASIC, plus seven manuals documenting the three languages.

The beauty of this Language System is that it speeds up execution and helps cut unwieldy software development jobs down to size. Also, because the languages are on diskette, loaded into RAM, you can quickly and economically take advantage of upgrades and new languages as they're introduced.

Apple's Pascal language takes full advantage of Apple high resolution and colour graphics, analog input and sound generation capabilities. It turns the Apple into the lowest priced, highest powered Pascal system on the market. With Pascal, programs can be written, debugged and executed in just one-third the time required for equivalent BASIC programs. With just one-third the memory.

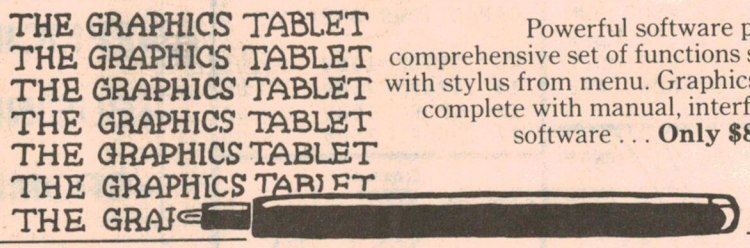
On top of that, Pascal is easy to understand, elegant and able to handle advanced applications. It allows one programmer to pick up where another left off with minimal chance of foul up.

Because Apple uses UCSD Pascal,™ you get a complete software system: Editor, Assembler, Compiler, and File Handler. And because we adhere to the standard, your programs run on any UCSD Pascal system with minimum conversion. Which is really something an enthusiast can get enthusiastic about.

Apple Language System **NOW AVAILABLE @ ONLY $495.00***

Requires 48K Apple II Computer and Disk II & Controller.

The GRAPHICS TABLET is an image input device to enter pictorial information directly into the Apple II Computer. eg from:
– maps and photographs
– logic diagrams and schematics
– histograms
– architectural drawings – fine art



Powerful software provides comprehensive set of functions selected with stylus from menu. Graphics Tablet complete with manual, interface and software . . . **Only $874.00***

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Microcomputer News & Products

Acorn Computer system

Cottage Computers will be supporting and marketing the Acorn Computer range of microsystems and modules from England. The Acorn system is based on Eurocards and uses the popular 6502 microprocessor.

The range covers microcontrollers up to the System 3 with floppy disk drives. A feature of the range is the VDU card which will generate Teletext characters and has full colour capability. Soon to be released is a Pascal package which will run on the 6809 CPU board which also plugs straight into the system.

Further details and demonstrations can be had at the Cottage Computer shop at 386 Queens Parade, Fitzroy North, Victoria 3068.

Dot matrix printer

Although specifically designed for connection to the Tono series of communications computers, the HC800 dot matrix impact printer from Tono Corporation is fully compatible with the parallel Centronics interface. The HC800 is a bidirectional printer capable of printing 125 characters per second on standard fan-fold paper. Character width can be adjusted under program control, and the programmable Vertical Format Unit allows full control of vertical formatting with single control codes.

Full upper and lower case ASCII characters can be printed in a 9 x 7 dot matrix format, and character spacing is software selectable to give 40, 80 or 132 columns per line. The printer incorporates an 80 character buffer memory, and also has a self-test string generation facility.

The retail price of the printer is around $970, and it should be available by May, from Vicom Pty Ltd, who are distributors in Australia for Tono products. Vicom's address is 68 Eastern Rd, South Melbourne, Victoria 3205.

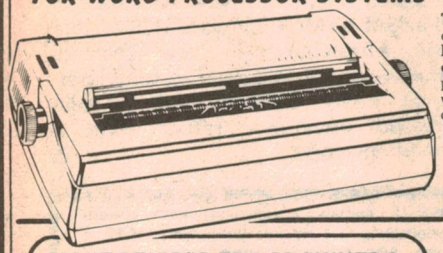
Free Programs from NZ

To help foster microcomputing as a recreational and educational tool, Micro Computer Research is supplying free programming hints plus a free Basic game program to interested microcomputer owners. Although primarily designed for TRS-80 owners with Level 1 and 4K minimum memory, this should be of value to all enthusiasts.

Interested readers in New Zealand can send a SSAE to MCR Software, 338 Marine Parade, Christchurch 7, New Zealand. Australian readers will need to send International Reply Coupons and a self-addressed envelope, rather than a stamped envelope.

HARDWARE

PROFESSIONAL DAISY WHEEL PRINTER
FOR WORD PROCESSOR SYSTEMS



This superb unit is a self-contained printer with in-built asynchronous serial interface conforming to the established RS-232C standard. It prints on business stationery up to 380mm wide at the rate of 45-65 characters per second – three times faster than golf-ball typewriters. Top quality office systems printer that is below competition prices. . .

NOW WITH RS-232 & CENTRONICS SWITCHING.

$3,390.00

Cat. X-3260

THE SORCERER

Cat. X-3001 **SORCERER**

Cat. X-1196 **MONITOR**

The Sorcerer is the expandable Z-80 based microcomputer that allows you to add peripherals to take it from basic computing through to advanced office business systems.
● 16K RAM expandable to 48K (on board) ● Serial I/O and Parallel I/O ● S-100 BUS compatible ● Cassette I/O for two recorders at speeds of 300 or 1200 baud ● Video I/O – 1920 characters full screen ● Full ASCII 128 characters (64 defined characters and 64 undefined characters) ● Graphic resolution 122,880 pixels ● Includes 8K BASIC plug-in ROM PAC™ in MICROSOFT™ ● Dimensions 490 x 330 x 100mm ● Weight 6 kilograms.
(Ask for our FREE comparison chart between the Sorcerer and other well known computer brands).

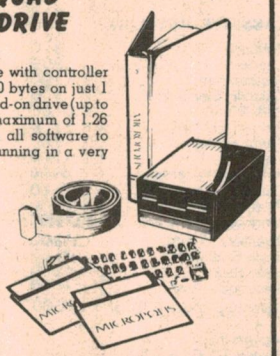
$1,395.00

LIGHT PEN FOR TRS-80 OWNERS

SCOOP PURCHASE of light pens from the USA – draw on the VDU – it's educational and fun. . .
● Uses your cassette recorder as a pre-amplifier ● Comes complete with cassette containing two application routines: TIC-TAC-TOE and 'menu' display routine ● Give your TRS-80 level II an 'eye' ● Uses 9V transistor battery (not supplied).

Cat. X-3645 **$29.50**

MICROPOLIS™ QUAD DENSITY DISC DRIVE



The Micropolis mod 2 drive with controller enables you to store 315,000 bytes on just 1 disc. By adding the mod 2 add-on drive (up to 3) you can obtain up to a maximum of 1.26 Megabytes! Complete with all software to enable you to be up and running in a very short time.

Model 1043/mod 2 with controller.
Cat. X-3205 **$1,350**
Model 1023/mod 2 add-on
Cat. X-3208 **$750**

VIDEO MONITOR

This is a superb 30cm black and white video monitor that can be used on AC and DC. Simple connection to your computer. Features jitter free and distortion free characters. Can be used with most computers on the market.

Cat. X-1196 **$149.50**

WORD PROCESSOR PAC™

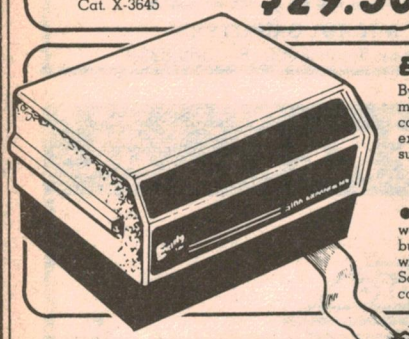
Remove the plug-in BASIC PAC™ and replace it with the powerful WORD PROCESSOR PAC™ and you will have the basis of an office computer system.
Features: ● Automatic text wrap ● Automatic checking of drastic commands ● Powerful search function ● Auto commands ● Macro programming – all this plus extensive user instructions.

Cat. X-3085 **$275.00**

SPECIAL WORD PROCESSOR KEYS

To enable you to use the Sorcerer's Word Processing function more readily we can supply specially embossed keys (11 units) to replace the normal beige keys. The colour allows you to identify the special keys immediately. Just another touch of professionalism for the Sorcerer owner. . .

Cat. X-3086 **$14.95**



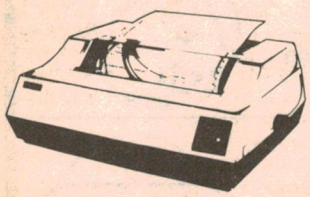
EXIDY S-100 BUS EXPANSION

By using plug-in cards with the S-100 BUS and your Sorcerer you can use many other manufacturers peripherals (see our special 'Blue Board' cards on this page). The world of computing has been made even more exciting through the S-100 BUS. Comes complete with in-built powre supply, ribbon cable and connector.

Cat. X-3010 **$499.00**

● Allows up to 6 plug-in cards ● Connects directly to Sorcerer's 50-way expansion socket via supplied cable ● All S-100 lines fully buffered ● Separate 2.000MHz crystal clock provided for S-100 cards which cannot use the Ø1 and Ø2 clock signals derived from the Sorcerer's 2.106MHz clock ● Provision for mounting up to six 25 pin "D" connectors for additional I/O ports, etc.

C.ITOH BRAND DOT MATRIX PRINTER



The model 8300P dot matrix printer is a no-nonsense unit that can churn out the full 96 character ASCII at a brisk 125 characters per second on standard fan-fold paper. Character spacing of 80, 40 or 132 columns which are software selectable. A quality unit that costs less than $1,000!!

Cat. X-3255 **$970.00**

DYNAMIC EXPANSION KITS

These are top quality ICs that can expand your basic 16K Sorcerer to 32K or even 48K (expands the 8K to 16K etc). They can also be used with the TRS-80 level I and II and the Apple II computers to expand their on-board RAM. Superb value and complete with installation instructions.

Cat. X-1185 **$109.50**

CASSETTE RECORDER

$79.95

For cassette storage of data, or for loading programs into your Sorcerer you need a quality cassette recorder that has been tested and found to be reliable. The National Panasonic was tested by us along with other units and came out as the best unit available in its price range. Works on AC or DC and can be controlled from your Sorcerer.

Cat. A-4095

JABEL COMPUTER MAINS FILTER

Having trouble with memory crashes? Then the answer is the Jabel Mains Filter – it will remove those annoying spikes from the 240V mains and thereby protect your memory!

Cat. M-9850 ..... **$75.00**

SERIAL DATA CABLE

Connect 2 cassette recorders to your Sorcerer and be able to control them both from your computer keyboard.

Cat. X-3110 ..... **$34.50**

PRINTER INTERFACE CABLE

Connect your Sorcerer to the C.ITOH printer or any Centronics compatible printer.

Cat. X-3112 ..... **$49.50**

SEE OPPOSITE PAGE FOR DICK SMITH STORE ADDRESSES

FAMOUS 'BLUE BOARD' PLUG-IN CARD MODULES FOR THE S-100 BUS. . .

And now for the famous 'Blue Boards' from SSM in the US of A. Three boards available for your S-100 unit in ready built form or as kits with comprehensive instructions.

2 PARALLEL & 2 SERIAL I/O BOARDS

2 serial I/O ports (2 in and 2 out) with full handshaking status from UART's and 2 latched I/O ports (2 in and 2 out) using 8212 latch buffers. Independent DIP switches for setting address of serial and parallel port blocks. Ideal for the person who wishes to control a number of appliances in the home, office and factory.

Built unit Cat. X-3300 **$250.00**
Kit form Cat. X-3301 **$190.00**

MUSIC SYNTHESISER BOARD

A fantastic synthesiser with a frequency range of 15Hz to 25KHz with a nine octave frequency change via software. Attack and sustain can be defined by user. Includes "MUS-X1" a high music interpreter which can drive up to 8 boards at once – even includes a music program to get you up and going fast!

Built unit Cat. X-3305 **$310.00**
Kit form Cat. X-3306 **$250.00**

8K & 16K PROGRAMMER & 4K/8K EPROM BOARD

Now you can program your EPROM's (2708 or 2716) and also have the facility for on-board 4K of 2708 or 8K of 2716 EPROMs. This extends the capabilities of your computer system and provides a powerful unit for those who wish to do their own programming on EPROMs.

Built unit Cat. X-3310 **$250.00**
Kit form Cat. X-3311 **$190.00**

SOFTWARE

FROM

DICK SMITH ELECTRONICS

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	162 Pacific Highway,	GORE HILL.	Ph 439 5311	QLD	166 Logan Road,	BURANDA.	Ph 391 6233
	30 Grose Street,	PARRAMATTA	Ph 683 1133		842 Gympie Road,	CHERMSIDE.	Ph 59 6970
	263 Keira Street,	WOLLONGONG.	Ph 28 3800	ACT	96 Gladstone Street,	FYSHWICK.	Ph 80 4944
	613 Princes Highway,	BLAKEHURST	(Opening Soon)	SA	60 Wright Street,	ADELAIDE.	Ph 212 1962
				WA	414 William Street,	PERTH.	Ph 328 6944

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BRISBANE: Half hour earlier.
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RE-SELLERS OF DICK SMITH PRODUCTS IN MOST AREAS

FOR YOUR SORCERER

MAGIC MAZE
A challenging game with 10 levels of play – wander through the maze and meet many obstacles. Automatic scoring on screen.

Cat. X-3620 ..... **$14.95**

PLOT
Get superb graphics in both super high resolution mode and quick low resolution mode.

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Z-80 DISASSEMBLER
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DSE757

Commodore CBM computer system

The Commodore CBM 3032 is a computer system designed particularly for use in small businesses. It is supplied complete with dual floppy drive system and an 80-column tractor feed printer. It is backed by a large number of software packages which make it applicable to most business and professional fields.

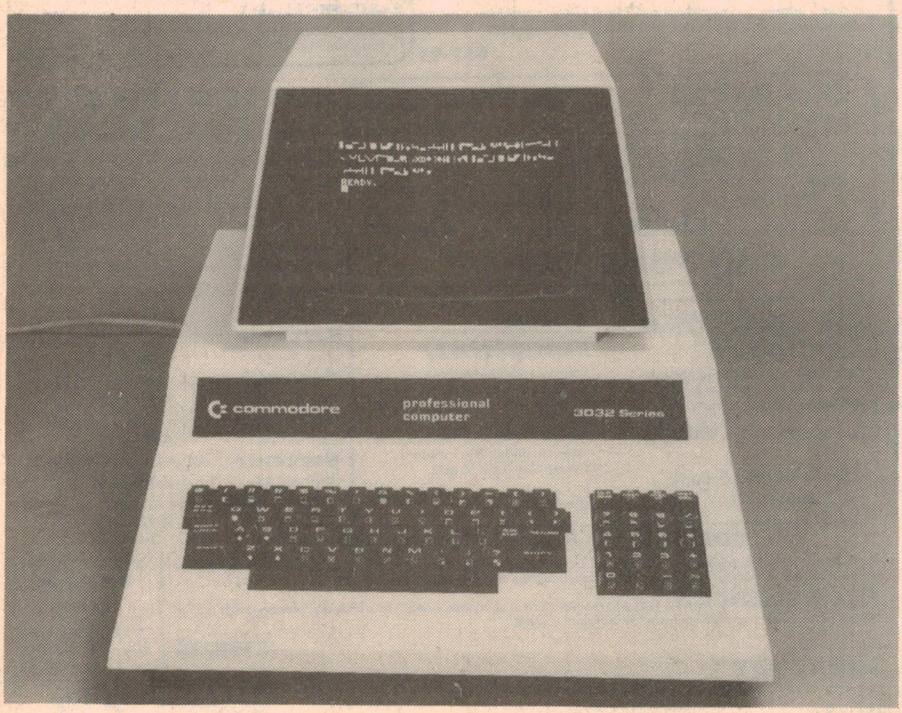
by PETER VERNON

The system we reviewed was the CBM Professional Business System, comprising the CBM 3032, the 2040 Dual Drive Floppy Disk and the 2022 Tractor Feed Printer. Commodore are marketing this system as an integrated package for business use, although their earlier machine, the PET, was aimed more at the "home computer" market.

Because of this the CBM 3032 has many features that make it attractive to the hobbyist as well as to the business user. The special graphics characters can be used for games and video art as well as for the generation of graphs and visual presentations of business data, and many games programs are available, in addition to a comprehensive range of commercial applications software.

The most immediately striking thing about the Commodore CBM 3032 is the built-in 22cm video monitor, enclosed in a stylish fairing above the keyboard. Most small microcomputer systems require connection to an external video monitor, which is often a hidden component of the overall cost.

The keyboard itself is a conventional 73 key stepped keyboard, with a separate numeric keypad and 64 special graphics characters. Unshifted, the keyboard gives upper case characters: press the shift key and the special graphics characters are instantly available.



This photograph shows the special graphics character set of the CBM 3032. The characters correspond to the legends on the front of the key tops.

Lower case characters are available by using a Basic instruction to poke a data byte to a location in RAM. In this mode the shift key gives lower case. Because of this arrangement, the graphics characters and lower case letters are mutually exclusive. Both cannot be displayed at the same time, although, as we will see, both can be printed on the same line by an attached printer.

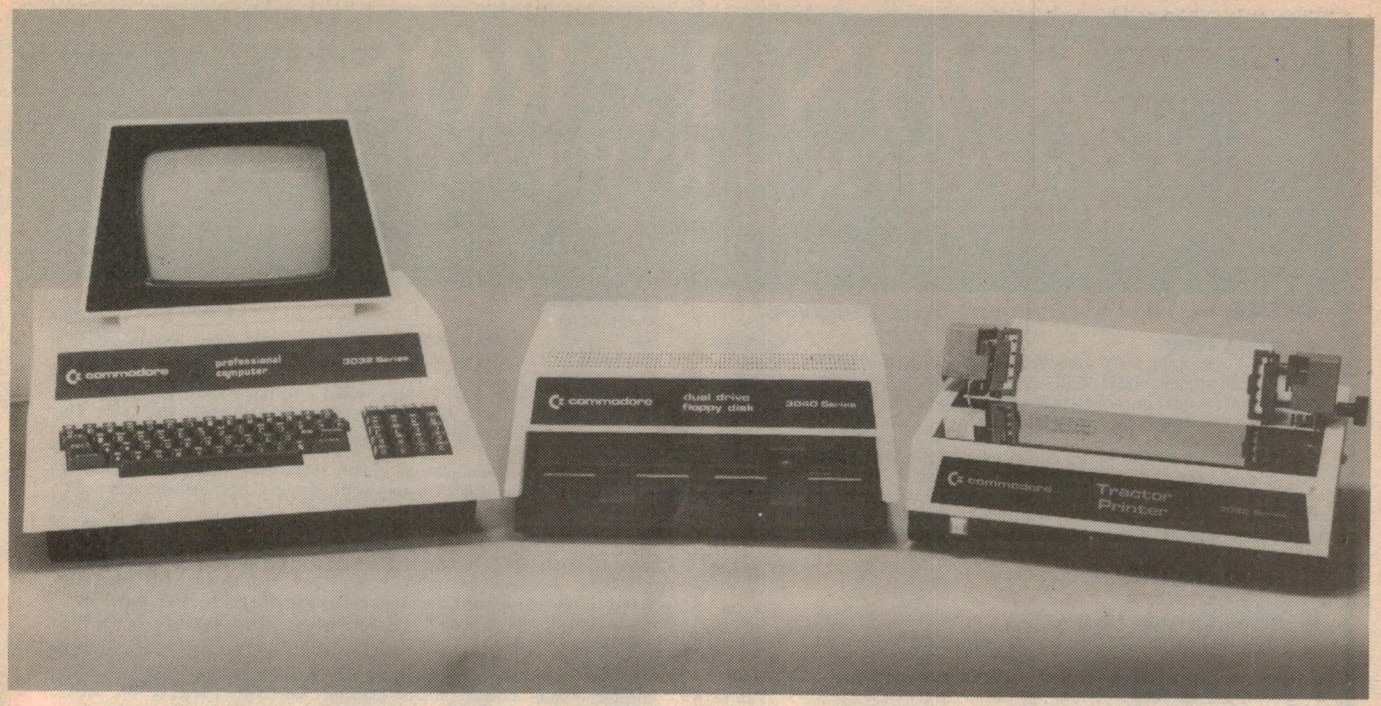
When the machine is turned on the value of the built-in monitor becomes apparent. The green phosphor display presents bright, clearly readable 8 x 8 dot matrix characters with excellent definition, in 25 lines of 40 columns. Using the CBM 3032 is very easy on the eyes.

For many business applications a 40 column line is not long enough, however. Realising this, Commodore have provided the CBM with the capability of defining more than 40 characters as a line. When the cursor reaches the end of the first line it automatically jumps to the next line, and the display continues without a space. The end of the line is marked by the closing quotes. In this way two lines of 40 characters on the screen can be printed as a single 80 character line.

While this capability overcomes the limitations of small screen size, it is a little confusing to use. It is easy to forget, for example, that moving the cursor down one line does not automatically create a space. It is also easy to forget that the extended line feature only operates for two lines. Attempting to continue onto a third line results in a syntax error.

The keyboard of the CBM is not exactly comparable to a typewriter keyboard. For example, there are no numbers on the upper keys, these being confined to the numeric keypad. The upper keys contain the punctuation normally used in Basic programming, such as "" and (), which are available without using the shift key. This allows some time saving in entering programs, but is likely to confuse a user already accustomed to a conventional typewriter keyboard.

The keyboard has a couple of annoying features. There is no Reset key, so if the user is "locked out" by a misbehaving program, the only solution is to turn the machine off and then on again. This is annoying when developing programs in Basic, and even more disadvantageous when working with the Machine Language



The CBM 3032 Professional Computer with the 2040 Dual Drive Floppy Disc and the 2022 Tractor Feed Printer.

monitor developing machine language programs.

Looking at some of the physical specifications, the CBM 3032 is 415mm wide by 460mm deep, with an overall height of 350mm (including the video monitor), and weighs 20kg. Unlike many other small systems, the CBM 3032 is packaged in a sheet steel case, giving it a very solid "feel" and engendering confidence in the system.

The CBM series is based on the MOS Technology 6502 microprocessor and has a Basic interpreter and operating system in 12K of ROM. In addition there is the 1K machine language monitor, TIM (for Terminal Interface Monitor). An 8MHz crystal oscillator is divided down to drive the processor at 1MHz.

The 3032 system, as the designation suggests, has 32K of available RAM. There is also a 3016 system which has 16K of RAM. Prospective purchasers should be aware that these amounts of RAM are fixed. If you buy a 16K system there is no provision for later on-board expansion. A memory expansion interface connector is available on the back panel but the memory boards which use a proprietary RAM chip, are not yet in production.

One of the best features of the CBM 3032 is the screen editing facility. A group of cursor control keys allows the user to move the cursor about on the screen and to insert and delete characters at will. While this is not unique, the Commodore has further refinements. When the cursor movement control character is included within quotation marks as part of a Print statement in a program, the cursor movement becomes part of the program, so that the cursor can be positioned on the screen in order to print in a specific position under program control.

By using various combinations of cursor movement control characters it is easy to program animated displays or to exactly specify a printing format. Each cursor movement control character moves the cursor one space, however, the lack of a repeat key is a disadvantage here. There is no way to speed up the process by using Repeat to give multiple key operations. For example, to print a character in the 35th column, 34 Cursor right characters must be included in the Print statement, or a program loop used.

Another feature is the reverse video display, controlled by a single key. By using the Reverse key any of the standard character set or the special graphics may be displayed in reverse (ie black on white). Like the cursor controls, Reverse may be contained within quotes in a Print statement, so that the reverse video display can be turned on and off under program control. The Reverse command really doubles the size of the CBM character set, allowing, for example, 64 graphics characters in reverse video, as well as the same 64 characters printed white on black.

The ROM-resident Basic of the CBM is the standard Microsoft language with a few special additions. The CBM contains an on-board clock, which is reset when the machine is switched on, and is interrupt-driven by the processor. By entering PRINT TIME$ the current value of this clock can be displayed. This value can be set to current time, which will be accurately maintained for as long as the machine is on.

One trivial use for this feature is the World Clock program distributed by Commodore, which when run displays a map of the world showing the current time of day in a number of major cities. Other uses include games, logging computer time, and real-time control applications.

The Basic of the CBM 3032 includes all the usual scientific functions, and also has a nine digit value for pi built in. Calculations can be made in floating point form or scientific notation, with exponent values between ±38 and up to 10 significant digits in the mantissa.

CBM Basic also includes a useful statement, GETA$, which will input a single character from the keyboard. It can be used like this:

```
—
70 PRINT "HIT ANY KEY TO CONTINUE"
80 GET A$: IF A$="" THEN GOTO 80
```

Line 80 will fetch a single character from the keyboard. If no key is pressed, (A$="") then the program will remain in a loop until a key is pressed. The GET statement is not limited to keyboard input. GET will also fetch a single character from a peripheral device.

The CBM Machine Language Monitor is more extensive than most. The usual Enter and Display routines are available but in addition, TIM includes subroutines for reading and writing characters on the video display, entering hexadecimal data, and software interrupt and breakpoint functions. Further, on entering the monitor via the Basic command SYS 1024, the monitor will display the contents of the registers of the 6502, the program counter, status register X and Y index registers and stack pointer. Programs written in machine language can be entered from Basic programs using the standard USR(O) command as well as SYS. Thus the monitor of the CBM seems well adapted for developing machine language programs for the 6502. It is a pity about that absent Reset switch though.

The CBM 3032, in common with all Commodore products, uses the IEEE-488 interface standard for input and output. The use of such an interface on a hobbyist machine

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OPAL — *The OPAL is available in two forms:*

a) OPAL 1000 **$4,800.00**

The OPAL is an 8 slot S-100 system conforming to the new IEEE standards. A Delta Products Z80a 4MHz CPU card with 2 RS232c serial and 3 × 8 bit parallel ports is used in conjunction with the Delta Products Disk Controller. Memory is 64k dynamic RAM. Disk drives are 2 × 8in Shugart SA801R running at double density 480k/drive) fitted with our exclusive Disk Saver which prolongs the life of the drives and floppy disks and thus reduces routine maintenance. The Disk Saver also reduces the risk of data loss due to power failures. The software is CP/M version 2.3 with Delta Product's utilities. A PROM monitor is supplied. The system is mounted in an attractive pressed Aluminium housing with a cast front panel fitted with reset button and key operated on/off switch.

OPAL 1000 with 64k Static RAM **$5,400.00**

b) OPAL System 1000

Terminal: Lear siegler ADM-42 or Beehive DM-20

Printer: NDK S-2000
CPU: OPAL 1000
Delivery: 2-3 weeks
Price: $9,650.00

Tape Backup $1,010.00

The Corvus Mirror (described under "BACKUP") allows the use of a video cassette recorder as a 100 Megabyte tape backup with random access. Transfer rate is 1.1 Megabaud (10 Megabytes in about 10 minutes). The MIRROR can be used for archival purposes. Price includes installation.

Hard Disk $5,830.00 The Corvus 10 Megabyte Hard Disk has a transfer rate of 62k bytes/second. Price includes the disk, S-100 interface and installation.

Additional Hard Disk $4,104.00

Shugart SA1000 Hard Disk and Double sided drives to be released soon.

THE GENERAL ACCOUNTING PACKAGE $1,000.00

The system, written for John F. Rose Computer Services Pty Ltd, is a fully integrated Creditors, Debtors and general ledger package with facilities for online enquiries of all modules at any time. Data entry is in batch mode with a batch proof. An incorrect batch may be deleted before update. The system has been written in Microsoft Basic and Compiled under Microsoft's new Basic Compiler to produce an extremely fast package.

GENERAL LEDGER FEATURES — A user defined chart of accounts allows flexible reporting for small business. All standard accounting reports may be prepared (Trading account, profit and loss account, balance sheet etc) by defining the required account and nominating which detail accounts add to that account. Special reports may be prepared in a similar manner. Up to 400 accounts may be used in the standard system. A chart of accounts, financial report and audit trail may be produced at any time. There is provision for an annual budget, month and year-to-date balances and a comparison with last year's results.

DEBTORS LEDGER FEATURES — The Debtors module is a conventional brought forward system which allows up to 400 debtors in the standard system. Reports include: Debtor statements for a single or range of debtors, an aged trail balance, a listing of debtors on file and provision for the analysis of sales this month, year-to-date and last year for each debtor.

CREDITOR LEDGER FEATURES — The Creditors module is a conventional brought forward system which allows up to 400 creditors in the standard system. Reports include: Creditor Remittance Advices for a single or range of creditors, an aged trial balance, a listing of creditors on file and the provision for analysis of purchases this month, year-to-date and last year.

FILE SPACE REQUIREMENTS — A system using 400 debtors, 400 creditors and 400 general ledger accounts requires approximately 198k of disk storage for master file data.

500 debtor and 500 creditor entries per month with a single general ledger dissection will require approximately 102k of disk storage. Multiple General Ledger distributions will require additional disk storage.

EACH RECORD REQUIRES:

Debtor Master	202 bytes
Creditor Master	202 bytes
General Ledger Master	76 bytes
Debtor Transaction	40 bytes
Creditor Transaction	40 bytes
General Ledger Transaction	62 bytes

Each debtor and Creditor Entry generates 2 General Ledger Transactions. The system has been designed to be easily upgraded for Hard Disk.

MICROSOFT

BASIC — 80 **$305.00**

Disk extended BASIC. ANSI compatible with long variable names, WHILE/WEND, chaining, variable length file records, Random access etc.

Basic Compiler **$355.00**

Language compatible with BASIC-80 and 3-10 times faster execution. Produces standard microsoft relocatable binary output. Includes macro-80. Also linkable to FORTRAN-80 or COBOL-80 code modules.

Fortran-80 **$405.00**

ANSI '66 (except for complex) plus many extensions. Includes relocatable object compiler, linking loader, library with manager. Also includes macro-80.

COBOL-80 **$630.00**

Level 1 ANSI '74 standard COBOL plus most of level 2. Full sequential relative and indexed file support with variable file names. STRING, UNSTRING, COMPUTE, VARYING/UNTIL, EXTEND, CALL, COPY, SEARCH, 3-dimensional arrays, compound and abbreviated conditions, nested IF. Powerful interactive screen-handling extensions. Includes compatible assembler, linking loader and relocatable library manager as described under macro-80.

MACRO-80 **$155.00**

8080/Z80 Macro assembler. Intel and Zilog mnemonics supported. Relocatable linkable output. Loader, library manager and cross reference list utilities included.

XMACR086 **$300.00**

8086 cross assembler. All macro and utility features of macro-80 packages. Mnemonics slightly altered from Intel's ASM86. Compatibility data sheets are available.

EDIT-80 **$105.00**

Very fast random access text editor for text with or without line numbers. Global and intraline commands supported. File compared utility included.

MICROPRO INTERNATIONAL

Super-Sort I **$230.00**

Sort, merge, extract utility as absolute executable program or linkable module in Microsoft format. Sorts fixed or variable records with data in Binary, BCD, Packed Decimal, EBCDIC, ASCII, floating, fixed point, exponential, field justified, etc. Even variable number of fields per record.

WORDSTAR **$450.00**

Menu driven visual wordprocessing system for use with standard terminals. Text formatting performed on-screen. Facilities for text paginate, page number, justify, centre and underscore. User can print one document whilst editing a second. Edit facilities include global search and replace, read/write to other text files, block move and copy, etc. Requires CRT terminal with addressable cursor positioning.

WORDSTAR — CUSTOM **$775.00**

Wordstar customised to take advantage of your Terminal's function keys. Functions are directly accessable from the keyboard — all cursor control functions and important file handling functions. Clear plastic instruction sheet for mounting above the keys on the terminal can be provided.

WORDSTAR Interfacing manual **$175.00**

WORDSTAR/MAIL MERGE (available May '80) **$580.00**

Wordstar with the option for production mailing of personalised documents with a mail list produced by DATASTAR or NADS.

DATASTAR **$355.00**

Professional forms control entry and display system for key-to-disk data capture. Menu driven with built learning aids. Input field validation by mask, length, attribute (ie: uppercase, lowercase, numeric, autodup etc). Built in arithmetic capabilities, using keyed data, constants and dervied values. Visual feedback for ease of forms design. Files compatible with all CP/M, MPM supported languages. Requires 32k RAM.

WORDMASTER **$130.00**

Text Editor. In one mode has a superset of CP/M's ED commands including global searching and replacing, forward and backward in the file. In the video mode, provides full screen editor for users with serial addressable cursor terminal.

TEX-WRITER **$85.00**

Tex-Writer is a text formatting program that can be used to print files created by an editing program. Form letters can be printed from a mailing list file and personalised with automatic name and address insertion. Long documents can be segmented into several short sections for easy editing and then linked automatically when printed by TEX-WRITER. The text formatting commands are inserted into the text.

MDBS-DRS (Z80) **$860.00**

MDBS with Dynamic Restructuring option which allows altering MDBS data bases when new ITEMs, RECORDs, or SETs are needed without changing the existing data.

When ordering, specify if the version required is for the Microsoft L80 or Mbasic 80 version Basic.

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is questionable, for while it is the standard interface for scientific instrumentation, very few peripherals available to the hobbyist use the IEEE-488 standard. In particular, S-100 boards cannot be used with the CBM, and Commodore has no plans to introduce an IEEE-488 to S-100 interface.

For a business user this is less significant. Commodore produce their own floppy disk system and printers designed to connect to the IEEE-488 interface, and also have available an IEEE-488 to RS232C adapter. As well as the 2022/23 series of dot-matrix printers, Commodore market a Diablo daisy-wheel printer with a built in conversion to the IEEE-488 interface, for applications where the superior print quality is important.

In addition over 200 peripherals which use the IEEE-488 interface, including x-y plotters and data logging instruments, are available from other manufacturers. The price of these instruments may well place them out of reach of the hobbyist, however.

The CBM integrated system is quite impressive with the dual disk drives and printer. Commodore advertises these as "intelligent peripherals" and they are that. The dual floppy disk unit, for example, contains two microprocessors, an operating system in ROM, and RAM buffer memory. One microprocessor is a dedicated controller for the disk drives, and the second interfaces the disks to the CBM.

This gives the disk system great versatility and provides significant time savings, as the disk unit uses none of the main processor time or RAM memory. It is possible, for example, to copy one disk to another while the main processor runs a different program. A DOS Support program included on the demonstration disk that comes with the system takes all the work out of managing the disks. This program, once loaded from the disk using standard DOS (disk operating system) commands, allows the user to load programs with a single key-stroke.

Two standard 133mm disks provide a total of 340K of storage, without the use of double density techniques. In practical terms, this means that the utility disk provided with the CBM contains 20 programs, with 474 blocks of 256 bytes each left free. Few floppy disk systems can match this capacity. As well as the DOS Support program, this disk included a very well conceived disk maintenance program which allowed us to verify the validity of the programs on the disk, check their history and various other operating parameters.

My one reservation about the disk drives concerns the question of reliability. Whether it is the Commodore modifications to the Shugart 390 disk drives, the sample disks we received from the distributors, or my own unfamilarity with the system, I seemed to spend as much time studying the comprehensive list of error messages provided in the operating manual as I did actually reading and writing programs.

The other component of Commodore's professional system is the 2022 Tractor feed printer, a dot matrix (6×7) impact printer capable of reproducing both upper and lower case ASCII characters and the special graphics characters of the CBM 3032. Unless otherwise programmed it prints lines of 80 characters on standard 24cm fan-fold paper. Up to three copies of the original may be made simultaneously.

The printer is "intelligent," containing a microprocessor which allows programmable control of printing format, line width, decimal point position, line justification, and leading and trailing zeros. Control characters inserted in the program driving the printer allow enhanced (double-width) and reverse field characters to be printed.

The CBM 3032/Printer combination has some unusual features. The 40 column format of the CBM monitor does not directly translate to the 80 column format of the printer. As already mentioned, on the video screen there is an automatic carry over of lines which exceed 40 characters, so that 80 characters can be printed on two lines. When this double line output is fed to the printer it will be printed as one line of 80 characters.

The method of printing lower case is not immediately obvious. It requires that each line to be printed is preceded by a cursor down control character, which, when enclosed in quotes instructs the printer to shift to the lower case character set. Shifting back to upper case is done by using a cursor up character in the same way. It should be noted that the data which is entered will appear on the video monitor in upper case, but will be printed in lower case. It takes some time to become accustomed to the procedure.

Another characteristic that takes time to become accustomed to is the nasty grinding sound of the printer in operation. It sounds like it needs a drop of oil, but I was assured that the sound was normal. Many business users cover the printer with a transparent plastic top, partially muffling the sound.

The CBM 3032 is designed for easy expansion. In addition to the IEEE-488 interface connector, there is an eight-bit bidirectional I/O port, a cassette interface, and a memory expansion connector which provides access to the buffered input and output lines of the 6502 processor. In addition a video output and vertical and horizontal synchronisation signals are available to drive an external monitor, or for diagnostic purposes.

The cassette port, I/O port and IEEE-488 connector are well supported by a number of extended Basic statements allowing the user to read and write data to peripheral devices connected to the ports. A Verify command allows the user to check a newly made cassette tape against the program remaining in memory and reports any error in the recording process.

Overall the CBM 3032 professional system is well suited to business applications, once the user adapts to its special features. The dual disk drive provides fast, economical mass storage, and the user can write his own Basic programs or call on a library of programs from Commodore or other suppliers. Some of the programs available include General Ledger, Creditors Ledger, Stock Control, and the Commodore Business Information system program. A complete word processing program is also available.

The total price for the CBM 3032, the dual disk drive, and the 2022 printer is $6377. This compares quite favourably with the cost of similar small systems including disks and printer. The CBM 3032 computer alone costs $2249. Further information can be obtained from the distributors, Hanimex Pty Ltd, Old Pittwater Road, Brookvale, NSW, 2100.

PPM tape interface for small computers

This article describes a method for recording programs and data from a microcomputer onto a cassette recorder using pulse position modulation (PPM). The advantages of this mode are that the interface required is simple and inexpensive, and the necessary computer routines are short.

by J. G. LANG

CSIRO Division of Applied Geomechanics, PO Box 54, Mt. Waverley, Vic. 3149.

The writer has built a microcomputer like the Miniscamp (Electronics Australia," April, May 1977) but based on the Signetics 2650 microprocessor. Like the Miniscamp, the data is entered through console switches and displayed on a row of eight LEDs, but an important difference is that the two functions of entering the HOLD state and reading data from the console switches are separated. The advantage of this is that the data switches can be read on the run. Another difference is that 512 bytes of RAM are installed, instead of the original Miniscamp's 256.

All such small console switch oriented systems have one thing in common. Before very long you start to look for some means of recording your programs so as to minimise the time-consuming operation of reloading programs through the console switches. This article describes the writer's solution using Pulse Position Modulation (PPM) on an ordinary audio cassette magnetic tape recorder.

On account of cost and availability an unmodified cassette recorder is the obvious medium, but a choice must be made between several available modes for recording digital data. From amongst phase modulation (PM), frequency-shift keying (FSK), pulse-duration modulation (PDM) and pulse-position modulation (PPM), the last was chosen. PPM has the advantages that only a very simple interface is involved and the elemental loading program can be made quite short. The length of this program is important as it has to be loaded by hand every time the microcomputer is powered up. Note that we are dealing with simple systems with limited RAM and no ROM.

PULSE POSITION MODULATION

With PPM a string of pulses is stretched out in time or along a length of magnetic tape as illustrated in Fig. 1. All the pulses have the same shape but the time interval between them is varied to indicate different values. For binary data we only need two intervals and those used here are 1667*us* (microseconds) for a logical "**zero**" and 3333*us* for a logical "**one**." On replay, the time between pulses is measured. If the interval is less than 2500*us*, then it is represented as a "**zero**," if more than 2500*us* then as a "**one**." 3333*us* between pulses is equivalent to 300Hz and 1667*us* is equivalent to 600Hz. The discriminating interval of 2500*us* is half way between the two nominal values and thus gives the greatest possible latitude in accommodating variations from the correct pulse positions.

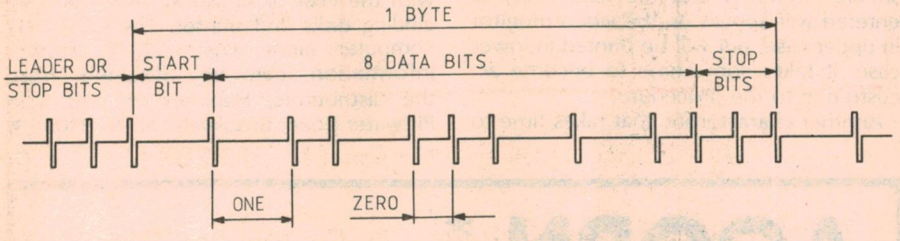

Fig. 1: typical pulse position modulation waveform showing the relationship between logical one and logical zero.

HARDWARE

The necessary interfacing hardware is simple and involves two circuits, one for writing to tape and the other for reading from tape.

The writing circuit is a pulse generator which delivers one symmetrical square wave pulse every time it is triggered. Both halves of a 74123 dual monostable are used in a cascaded arrangement. When a "negative-going" transition is applied to input pin 1 of the first mono it is triggered. When this mono recovers after a delay of 100*us* it triggers the second mono for a further delay of 100*us*. Resistor R3 is connected to the normally high output of the first mono and R4 to the normally low ouput of the second mono. At the junction of these two resistors the waveform shown on Fig. 2 is generated each time a trigger pulse is input.

If the pulse shaper were continually retriggered the output would be a continuous 5kHz square wave. While most cassette recorders will handle the fundamental of this waveform most will not do so well with the third, and higher harmonic components. Hence on replay, the waveform will be well rounded but this does not matter provided one definite pulse is returned for each pulse originally recorded.

For reading from a tape, the output from the cassette is connected to the circuit shown in Fig. 3 which uses a 555 timer IC connected as a Schmitt trigger. When the input to pin 2 goes below 1/3 Vcc the output at pin 3 goes high. It remains high until the input to pin 6 goes above 2/3Vcc when the output will change to low. Blocking capacitor C5 and resistors R6 and R7 put both inputs of the 555 at 1/2 Vcc when no signal is coming from the cassette recorder. When the volume gain of the recorder is increased until the signal swings above 2/3 and below 1/3 of Vcc the Schmitt trigger will produce a rectangular wave output at pin 3. Each time this waveform goes high the monostable formed by gates G1 and G2 generates a short duration negative going pulse. This pulse sets the RS flipflop formed by gates G3 and G4. The state of this flipflop is monitored at pin 8 by the

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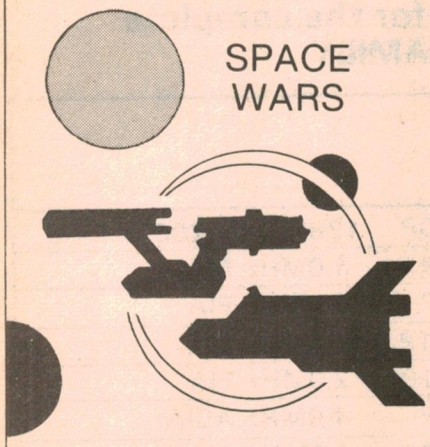

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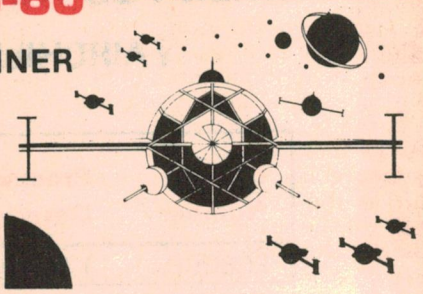

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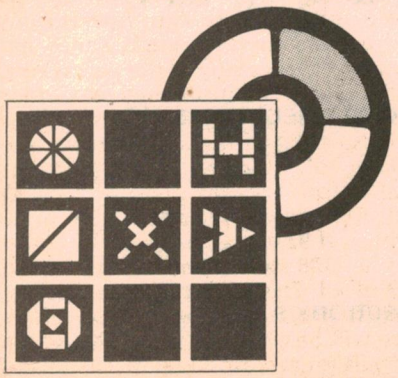

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microcomputer through its sense input. The flipflop is cleared by the computer outputting a short negative pulse on its flag output.

From the point of view of the computer, the operation of reading consists of repeatedly looping back to check the state of the flipflop. When the flipflop goes high the computer notes the fact, then promptly resets the flipflop. After each reset the computer starts counting the number of program loops before the next pulse causes the flipflop to be set again.

When reloading it is convenient if the signal going to the computer can be heard so the loading program can be started in the leader and the recorder stopped after the file has finished. However many cassette recorders only have one outlet and when this is used the internal speaker is muted. In these cases, a small external speaker can be connected in parallel with the input to the interface of Fig. 3. If this speaker has its own volume control in the form of a variable series resistor, then a suitable listening level can be set after the output of the recorder has been set to the level required by the interface.

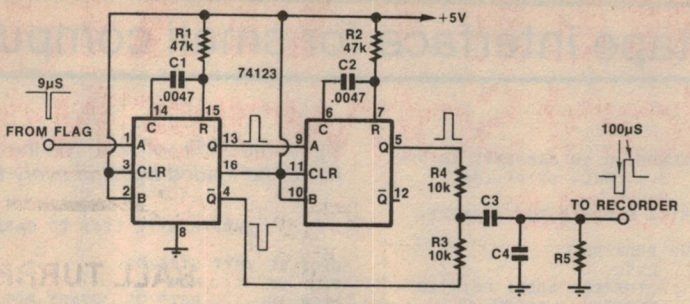

FIG. 2 : SYMMETRICAL PULSE GENERATOR

Fig. 2: the pulse generator circuitry. Both halves of a 74123 dual monostable in a cascaded arrangement are used to produce the waveform shown at the output.

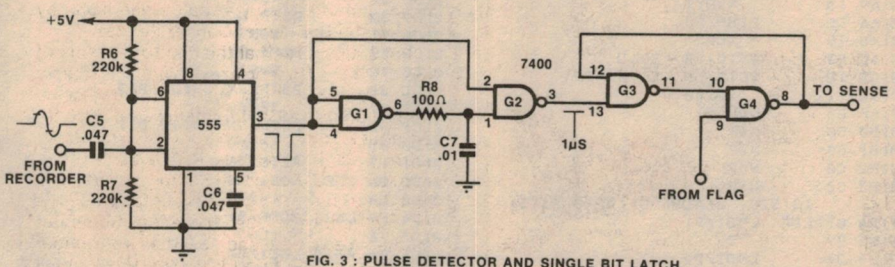

FIG. 3 : PULSE DETECTOR AND SINGLE BIT LATCH

Fig. 3: the tape reading circuitry. It uses just two ICS (a 555 timer and a 7400 quad NAND gate), three capacitors, and three resistors.

DATA RECORDING SYSTEM

How can we use the ability to measure the time between pulses to record and recover data on cassette tape? After trying a number of alternatives the following system has been adopted by the writer:

A "zero" bit is an interval of 1667 *us* and a pulse; a "one" bit is an interval of 3333 *us* and a pulse. Each data byte is recorded as a start bit (always a one), eight data bits and two stop bits (always zeros). The data bits are transmitted serially with the least significant bit (LSB) first and the most significant bit (MSB) last.

A record contains a maximum of 256 bytes, preceded by a three second leader of 1800 **zeros** and followed by a gap of at least one second duration.

In such a system, there is an arbitrary choice between whether the shorter interval will represent a **one** or a **zero.** The advantages of choosing the zero to be shorter interval are that the time for a given byte is shorter (one start, two stop bits), there are more zeros than ones on the average when the data is a program (the most used instructions have the simpler codes) and the bootstrap program is marginally shorter.

With this method of recording, the time taken by a byte will depend on the number of ones and zeros in the data. On occasions when it is necessary for all bytes to take the same time this can be done by adding an additional stop bit to the end of the byte for every zero in the data bits.

The type of bit used for the leader must be that with the shorter interval. This is so reading can be commenced anywhere in the leader and the first interval measured will always be less than the shorter interval.

The **start** bit must be of the opposite type to the leader so the beginning of a byte can be detected. The **stop** bits at the end of a byte are like a short leader between bytes and allow a little slack to pick up synchronisation at the next **start** bit. At the end of a byte the program will take momentarily longer as the byte just received is stored or otherwise disposed of.

Using a gap to mark the end of a record is very convenient with PPM as the gap can be detected while counting program loops to determine the type of bit. If the number of loops exceeds the time for a **one** by a suitable margin then this can be interpreted as an end-of-record gap. In practice it is convenient to say an end-of-record gap has occurred when the loop counter overflows and wraps around to zero.

From the above it is seen that there is a certain rationale running through the choice of how the intervals and bits are assigned for a system.

COMPUTER PROGRAMMING

Fig. 4 shows 2650 routines to save and load 256 byte blocks. The mnemonic code is written for a simple single byte assembler for which the operator characters have the following meanings:

%	assemble relative address
<	high-order byte of 15-bit address
>	low-order byte of 15-bit address
/	adjacent elements are to be ORed together
;	semi-colon and remainder of line are a comment
@	add in the indirect address bit

X1, X2, X3 are the indexing mode bits

All variable and constant identifiers commence with a letter while all numbers commence with a numeric character. If this character is a zero then the value is in hexadecimal, otherwise it is decimal. (This simple rule is definitive and saves the need to specify the number base by additional characters).

An address label must commence in the first character position of a line. Any other field must be preceded by a space.

With the computer for which the routines were first written, a WRTD (write data) or WRTC (write control) will cause the value in the designated register to be latched into the display LEDs. In addition the WRTC instruction will also cause the computer to go into the "hold" (pause) state until the "continue" switch is pressed. Thus while a block of data is being read, the number of bytes read is displayed. If all goes well, the computer will stop with the correct number of bytes showing in the display.

The program routine for writing to tape is reasonably straight forward but the reading routine needs some explanation particularly at the part where discrimination is made between ones and zeros.

Register R1 is used to count the number of program loops (each of 27*us*) before another pulse arrives. At CIL4, R1 is given an initial value of 36 decimal. If 92 loops are made the count goes to 128 which puts a **one** in the MSB of R1. This will occur after 2500*us*. Thus for intervals shorter than 2500*us* there will be a zero in the MSB and for intervals greater or equal to 2500*us* the MSB will be a one.

```
                ;
                ;RECORDING ON CASSETTE IN PPM.
                ;   J.G.LANG. 1979-1108.
                ;
                ;WRITE BLOCK Ø TO CASSETTE.
                ;
01A0 20 CIWØ  EORZ/RØ
01A1 93         LPSL
01A2 03         STRZ/R3   ADDR. POINTER
01A3 3B         BSTR/UN   LEADER
01A4 0F           %LDR
01A5 0F CW2     LODA/R3   NEXT BYTE
01A6 60           X3/<BLKØ
01A7 00              >BLKØ
01A8 3B         BSTR/UN
01A9 16           %WBYT
01AA DB         BIRR/R3
01AB 79           %CW2
01AC B3         WRTC/R3   HOLD
01AD 1B         BCTR/UN   DO AGAIN
01AE 71           %CIWØ
01AF C0         NOP
01B0 C0         NOP
01B1 C0         NOP
01B2 C0         NOP
01B3 C0         NOP
                ;3 SEC. LEADER OF ZERO BITS.
01B4 05 LDR   LODI/R1
01B5 07          7
01B6 06         LODI/R2
01B7 00           Ø
01B8 3B LDR2  BSTR/UN
01B9 1C           %ZERO
01BA FA         BDRR/R2
01BB 7C           %LDR2
01BC F9         BDRR/R1
01BD 7A           %LDR2
01BE 17         RETC/UN
01BF C0         NOP
```

Fig. 4: the 2650 software routines used to save and load 256 byte blocks. The program has to be loaded by hand every time the microcomputer is powered up.

```
                ;WRITE BYTE (RØ) TO CASSETTE.
                ;
01C0 C2 WBYT  STRZ/R2
01C1 C0         NOP
01C2 3B         BSTR/UN   START BIT
01C3 0E           %ONE
01C4 05         LODI/R1   BIT CNTR
01C5 08           8
01C6 52 WB4     RRR/R2    NEXT BIT
01C7 BA         BSFR/N
01C8 0D           %ZERO
01C9 3A         BSTR/N
01CA 07           %ONE
01CB F9         BDRR/R1
01CC 79           %WB4
01CD 3B         BSTR/UN   STOP BIT
01CE 07           %ZERO
01CF 3B         BSTR/UN   STOP BIT
01D0 05           %ZERO
01D1 17         RETC/UN
01D2 04 ONE   LODI/RØ
01D3 B4           180
01D4 F8 LN7   BDRR/RØ
01D5 7E           %LN7
01D6 04 ZERO  LODI/RØ
01D7 B4           180
01D8 F8 LN8   BDRR/RØ
01D9 7E           %LN8
01DA 74         CPSU      PULSE
01DB 40           FLAG
01DC 76         PPSU
01DD 40           FLAG
01DE 20         EORZ/RØ   MAKE POSITIVE
01DF 17         RETC/UN
```

```
                ;LOAD BLOCK Ø FROM CASSETTE.
                ;
01E0 77 CIL0  PPSL
01E1 08         WC
01E2 07       LODI/R3   POINTER
01E3 FF         -1
01E4 20 CIL2  EORZ/RØ   NEXT BYTE
01E5 05 CIL4  LODI/R1   NEXT BIT
01E6 24         36
01E7 74       CPSU      PULSE TO
01E8 40         FLAG    CLEAR LATCH
01E9 76       PPSU
01EA 40         FLAG
01EB B4 CIL6  TPSU      COUNT LOOPS TILL
01EC 80         SENS    NEXT PULSE SETS
01ED 98       BCFR/Z    LATCH
01EE 0B         %CIL8
01EF D1 CIL7  RRL/R1    HIGH BIT TO CARRY
01F0 50       RRR/RØ    HENCE TO BYTE
01F1 52       RRR/R2
01F2 9A       BCFR/N    START + 8 BITS?
01F3 71         %CIL4   NOT YET
01F4 CF       STRA/R3   STORE THE BYTE
01F5 20         X1<BLKØ
01F6 00            >BLKØ
01F7 F3       WRTD/R3   DISPLAY BYTE COUNT
01F8 1B       BCTR/UN
01F9 6A         %CIL2
01FA D9 CIL8  BIRR/R1   BUMP LOOP COUNT
01FB 6F         %CIL6   LOOP IF NOT ZERO
01FC B3       WRTC/R3   HOLD
01FD 1F       BCTA/UN   GOTO BCC CHECK
01FE 01         <CHKØ
01FF 80         >CHKØ
```

At CIL7 this bit is first rotated into the Carry, then into the MSB of Register R0 in which the data byte is being built up. As each new bit is received the pattern of bits in R0 is pushed right until the start bit (a **one**) is pushed out into the Carry. This is tested by seeing if R2 goes negative when the Carry bit is rotated into it. When the start bit has been pushed right through and out of R0 the remaining pattern is the required byte of data.

If the interval between pulses exceeds 5940*us* then the count will overflow and "wrap around" to zero which is interpreted as an end-of-record gap. This is tested at CIL8 as the loop counter is incremented.

ALLOCATION OF MEMORY

With 512 bytes of RAM it is convenient to think of these as two blocks, Block 0 and Block 1, each of 256 bytes. To avoid constantly getting tangled up or having to make unnecessary transfers, Block 0 (0000-00FF) is commonly used for the current user program and the first quarter of Block 1 (0100-013F) for the associated scratch-pad or working area.

The remainder of Block 1 (0140-01FF) is used for utility routines for transferring and checking data.

After the system is powered up, the console switches are used to enter an elemental loader at the end of Block 0, and a Branch Absolute instruction at location 0000. The elemental loader for loading Block 1 differs for the loader of Block 0 shown in Fig. 4 only at the absolute address, ie, 00F5 becomes 21 hex and 00FD, 00FE and 00FF become C0 hex (no operation). When this elemental loader is executed a 256-byte block of utility routines is read from cassette and stored in Block 1.

The CIL0 routine copies a block into Block 0. CIW 0 will write Block 0 out onto tape. The routine DAD moves progressively through a designated part of memory displaying the address and data (contents) of each location in turn. This is done by displaying first the high order byte of the address, then the low order byte, then the contents. Before each byte is displayed, its complement is flashed momentarily so that repeated patterns will be noticed, and the contents are displayed for three times as long as the address bytes so that they can be differentiated.

The load from cassette routines do not include any parity or redundancy checks as it is desirable that the elemental loader be as short as possible. Checking against transfer errors is done immediately after loading by running the routine CBCC which calculates a Block Control Character (by exclusively ORing, then rotating left) on a 256-byte block. Two versions of the routine are included, one for checking Block 0 and the other for Block 1.

As each routine is completed it enters the HOLD state. These routines are linked so that a CONTINUE will cause a jump to the next commonly used routine.

In conclusion it has been shown how, by using the techniques described above, and with just a minimum of hardware, quite a useful little microcomputer operating system can be built up which will considerably extend the usefulness of any console switch-based microcomputer.

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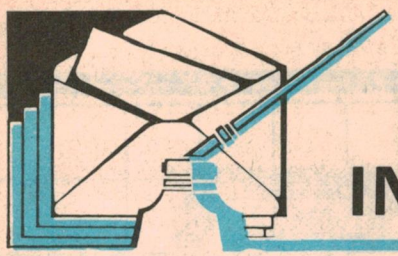

INFORMATION CENTRE

TRANSISTOR-ASSISTED IGNITION: I constructed this circuit from your December 1979 issue and it worked perfectly for a few days. Unfortunately, it has ceased to function due to a short-circuit of Q4, the BUX80. Could this have been due to excessive reverse voltage when the transistor turns off or have I been unlucky and picked a faulty transistor? If the former case applies, would a power diode, connected across Q4 so that it is normally reverse-biased, offer further protection. (P.O., Deer Park, Vic).

● As will be seen by examination of the oscillograms on page 63 of our December 1979 article, the BUX80 does not have to withstand a negative backswing when the circuit is working normally. However, if a sparkplug lead was open-circuit and no discharge took place then low frequency resonance of the coil primary would result in a negative "backswing" voltage being applied to the BUX80.

In this case, the base-collector junction of the BUX80 is forward biased by the backswing of the coil and thus any negative voltages which would otherwise be developed are clipped. This causes no damage to the collector-base junction of Q4 but diode D5 is included to protect the base-emitter junction and Q3.

This means that your suggestion of an additional diode would not really offer any further protection.

HALL EFFECT DEVICES: Your February article on Hall effect devices was of considerable interest to me as a railroad modeller. Track detection devices for N-scale (9mm gauge) are difficult to design with any degree of realism due to size limitations, and it seems that these Hall switches may overcome this problem. Could you please indicate the size of the Hall element required to meet my needs and suggest a suitable circuit to do the job.

It would help if the magnetic field surrounding the motor in the locomotive could be used to activate the Hall element. (J.G.O., Lenagh Valley, Tas).

● There are quite a number of different devices that would do the job for you J.O., but the type that would appear to be most suitable is one of the devices from Microswitch's range of 6SS types. These devices have a plastic body 5.3mm square, which could be mounted into the track by carefully cutting away two sleepers and mounting the device in their place. This lowers the device body to the same level as the sleepers, making them invisible to the casual observer.

The devices most suitable for this application are all available from Honeywell Microswitch Division or from their distributors. We suggest that you try the 613SS4 device which has an open collector output, thus allowing you to interface the device to any of the available logic families. If you desire a current sourcing output then the 612SS4 device will do the job. Suitable circuits for interfacing the devices were presented in the February article.

RLC BRIDGE: I have constructed your RLC Bridge described in the March 1978 edition of your magazine using a Dick Smith kit. I have found that the capacitance section of the bridge makes the meter move very erratically and it is hard to obtain the null. Further, in the resistance section there is hardly any meter deflection, so that the null obtained is very broad. I have checked my construction and believe that it is sound. Could you suggest any common mistake or design change that has occurred that could help me fix the bridge? (P. N., Geraldton, WA).

● There is no errata on the RLC Bridge circuit and we can only suggest that there is a faulty component in your circuitry. Since the meter is erratic in the capacitance measurement and hardly moves when measuring resistance, it would appear that the oscillator is not functioning properly. Check the resistors on pins 4, 6 and 7 of the 555 timer for open circuits or high value resistors. If these are OK, check the capacitor across the meter and the transistors and diodes in the null detector and diode pump circuit.

COMBINATION LOCK: I was flipping through the 1979 June issue of EA when I came across the electronic combination lock on page 44. I don't generally like to build a kit with perforated or matrix board. Are there kits available? (P. N., no address supplied).

● Printed circuit patterns both for the combination lock and the keyboard were included with the article and PC boards should be available from the usual sources. It would seem that you were confused about the PC pattern because of the matrix of programming holes which are used to set the combination – note these are not for mounting components.

We understand a kit of parts for the combination lock, complete with keys is available from Pre Pak Electronics, PO Box 43, Croydon NSW.

LED OSCILLOSCOPE: I was intrigued by the Circuit and Design Ideas item in the March 1980 issue suggesting the use of an LED display as an alternative to a cathode ray tube, in an oscilloscope. I have been an electronics hobbyist and EA devotee for many years, and like most others, have accumulated a range of simple test equipment, mostly home constructed (thanks to EA). However, much as I would like to have a CRO, I have never felt able to justify the outlay to buy one, nor had the confidence to try building one. I wonder if you think it might be worthwhile to develop the LED display idea into an article for a full constructional project? You could call it the "Poor Man's" CRO. (M. M. W., Blackburn, Vic).

● To obtain a similar resolution to that of a Cathode Ray Tube would require something like a 100 × 100 row by column array of LEDs. This adds up to 10,000 LEDs at say 10 cents each in 10,000 quantities . . . With a much cheaper 10 × 10 LED array, the resolution would be so poor it would be hardly worthwhile to view. Before we could attempt an LED oscilloscope then, we would need an array of LEDs in an LSI package available at a reasonable price and which also has on-board decoding of the array. The amount of wiring and associated electronics would then be reduced to a practical level.

MULTIPLEXING: I have noticed in a number of projects with seven-segment displays such as the digital capacitance Meter (March 1980), Playmaster AM/FM Tuner (Nov, 1978), and Upgraded 200MHz Digital Frequency Meter (August 1978) and a few others which use multiplexing for the displays. What is multiplexing and how does it work? What are its advantages and its disadvantages? (P. M., Lidcombe, NSW).

● Multiplexing is a technique for switching a number of signals so that they can all pass through a relatively small number of circuits or channels. In digital systems the most common form of multiplexing is known as time-division multiplexing, where different signals are passed through the same circuit at different times and are kept separate by the time delay between them.

In a three digit multiplexed display using seven-segment, common-cathode displays, the inputs for each segment are connected together, while the cathode connection for each digit is brought out separately. To display a number the appropriate segments of all the displays are

Reader experiences with CDI

CDI: I read with interest your comments in December 1979 issue p. 60 on the "possible" problems with a CDI unit. I have built the early EA verion (August '70) which has been in use (shared between two cars) since 1972, and served me well for at least a total of 100,000 miles. True, the original capacitor lasted only a few months, but since fitting the oil filled cap, the unit has been almost completely trouble-free. Contact breaker points in one of my cars are still the original, at some 80,000 **miles** of use.

In my experience the only criticism I can verify is the "lean power surge" downhill after slowing down by using the engine as a brake. I doubt if CDI is generally as bad as your article sounds. Viva CDI!

On another subject, having recently become interested in model radio control (I have a 10-year-old son), have you published any projects for even a simple system suitable for a boat (motor on/off and steering only)? Is a Telecom licence required? (P. J. P., Millicent, SA).

● Thank you for your comments on CDI. It is certainly true that our readers have had widely differing experiences with CDI. You have been one of the fortunate.

We haven't published a radio control system since 1965, when we described a hybrid transmitter circuit using valves and transistors in the December issue, and a hybrid receiver (Jan 1966). In the Feb 1970 issue we described a transistorised radio control receiver. It seems that a new look at the subject is long overdue. Complete control systems are now available on ICs which would allow a compact multichannel radio control system to be built up fairly easily (although perhaps not inexpensively). If sufficient interest is shown by other readers we will certainly look into the prospect. No licence is required for operation on the 27 and 29MHz radio control bands.

MORE ON CDI: Much has been said about CDI since its conception and I must agree with some of your readers, that some units can and will fail. I have run CDI in my Holden for four years and a company Mazda for two years without a single problem. No servicing was done other than an oil change for nearly 40,000km. I agree with the comment made that the secondary and feedback windings have to be wound as evenly as spaced as possible otherwise the converter will fail to operate consistently. Intermittent faults in my opinion are caused by two reasons. Firstly if the unit is located in a too hot position and secondly, converter starting problems are caused by an excessive voltage drop across the ballast resistor.

For a reliable CDI, I recommend that the car be set to the manufacturers specification and new points fitted for best results. Where there is a high oil mist within the distributor, the points will not self clean and the CDI will fail. Therefore I recommend the use of higher current through the points by using a lower resistance, say 50-30 ohms through the trigger circuit. In most cases I found that the engine needs to run slightly richer, especially on late model cars.

Some modifications are also recommended to allow the circuit to operate at a minimum of about 5V. These are increasing R1 to 2 × 48 ohm resistors and R2 to 2 × 38 ohm resistors. Also R3 should be reduced to 3 × 560 ohms. I also recommend the use of an oil filled sports coil. (R. K., Wellington, NZ).

energised, but only the selected digit is turned on via its cathode connection. If each digit is turned on and off more than about 50 times a second the persistence of human vision makes it appear as if all the digits are on at the same time.

The advantages of multiplexing are firstly a reduced total parts count and a reduced number of interconnections between parts. Multiplexed displays can also give a saving in power consumption, because some types of display devices are more efficient when operated in a pulsed mode than when operated continuously. LEDs, for example, can be driven at a higher current if the current is pulsed so that the average current does not exceed the rating of the LED. For the same current consumption a pulsed LED will be brighter than one which is continuously on, or the same brightness can be achieved with less current.

For three or less digits there is no saving in components, because the saving in seven segment decoders is balanced by the extra components required for switching and for selection of digits. However, no more switching circuitry is required for an eight digit display than for a three digit display, and digit selection requires only one transistor for each digit. Thus, for displays of four or more digits, display multiplexing results in significant reductions in components and current consumption.

The main disadvantage of multiplexed displays is the amount of electromagnetic interference which they generate. For eight digits, the clock frequency required to switch each digit on and off 50 times a second is 8 × 50, or 400Hz. Current levels switched each time may be in the region of 30mA, and the harmonics generated by this switching can be heard as a raucous buzz on an AM radio if used in close proximity.

The topic of multiplexing was covered in Part 13 of the series "An Introduction to Digital Electronics", which first appeared in our February 1977 issue. The series is now

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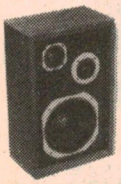

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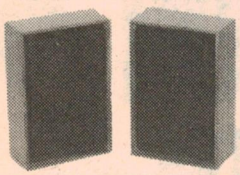

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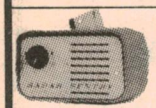

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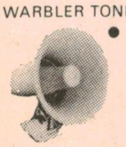

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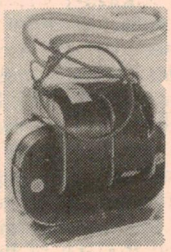

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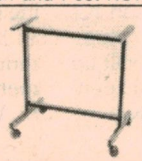

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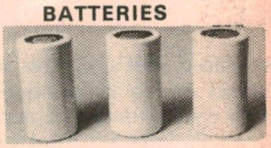

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Refer Dec 79 EA. New Products Review.

available in book form, under the same title, and is probably the best place to go for more information on multiplexing and digital techniques in general.

LIE DETECTOR: I built the lie detector (March 1980) and found I couldn't get good results using a 6mA centre reading meter. It just wasn't sensitive enough. I then used a 100uA centre reading meter and found it excellent. I always received a very noticeable deflection of at least 25uA when someone was lying.

I found I got better results if I moistened the part which has the aluminium foil (skin probes) connected to it.

I asked a person to write down a number between 1 and 10 and show it to one other person at least. I then ask them "Was it the number one?" They have to answer "no" to every number. As soon as they say "no" to the number they wrote down you notice a strong deflection on the meter. It always works.

Once the probes are connected the person must remain still and unemotional. I have also found a way of getting a negative reading, and I think I know a way to defeat the detector when you are being tested. (B. S., Doveton, Vic).

● The circuit described as "A simple Lie Detector" in our March 1980 issue is more correctly described as a resistance indicator. It can be used as a detector of emotional stress because stress causes the resistance of the skin to decrease.

For reasons as yet unknown, skin resistance can vary in odd ways. In addition, the human body produces a small DC voltage, which can be measured with a sensitive voltmeter. The whole subject of lie detection is a controversial one, and results are unpredictable at best. It is for this reason that lie detector tests are unacceptable as evidence in a court of law.

It is possible to defeat a lie detector by controlling skin resistance along the lines suggested by biofeedback researchers (see for example Barbara Brown's book "New Mind, New Body"). This degree of control of the "involuntary" nervous system can be achieved by anyone with the patience to practise consistently.

ELECTRONIC DISSOLVE FOR SLIDE PROJECTORS: With reference to your correspondent's letter in the January 1980 issue, I wish to point out that on at least two occasions in the last few years I have requested a design for a crossfade unit, the last time being in your reader survey form last year.

Your comment that not many people have access to two projectors is somewhat wide of the mark. It appears you are not in touch with the latest trends in Camera Club photography, where dual projection of audio-visuals has become standard practice. Many club members own two projectors and either use some form of mechanical fade unit or a simple electrical fade. Some people own units like the Animatic Convar but at about $450+ they are in limited number.

The requirements for a unit with sufficient flexibility to meet the needs of Camera Club members are as follows:—

1. Should handle lamps up to 24V, 250W.
2. Must have some means of encoding the hand control movements and slide changes on to tape. This may be either a variable frequency oscillator or digital control. Digital control appears to be less susceptible to switching clicks on tape. Separate controls for each projector are preferable to allow for superimposition of titles over existing pictures.
3. Triacs mounted in the projectors (space permitting) allow for much lighter control cables to be used.

What is needed is the control circuitry. Details of the mechanical modifications to projectors can safely be left to constructors. (J. A., Fairfield, Qld).

● No doubt such a project could be introduced, if sufficient interest was shown by other readers. Details of mechanical modifications to different types of projectors would **have** to be left to the constructor as you suggest but since readers of EA vary widely in their degree of experience, we wonder how practical this would be. Perhaps other readers have comments.

Electronics Australia Reader Services

If you are unable to complete an "Electronics Australia" project because you missed out on your regular issue, we can usually provide emergency assistance on the following basis:

PHOTOSTAT COPIES: $2 per project, or $2 per part where a project spreads over multiple issues. Requests can be handled more speedily if projects are positively identified, and if not accompanied by technical queries.

METALWORK DYELINES: Available for most projects at $2 each, showing dimensions, holes, cutouts, etc., but no wiring details.

PRINTED BOARD PATTERNS: Dyeline transparencies, actual size but of limited contrast: $2. Specify positive or negative. We do not sell PC boards.

PROJECT QUERIES: Members of our technical staff are NOT available to discuss individual projects, either in person at our office or by telephone.

REPLIES BY POST: Limited to advice concerning projects published within the past two years. Charge $2. We cannot provide lengthy answers, undertake special research or discuss design changes.

BACK NUMBERS: Available only until our stocks are exhausted. Within three months of publication, face value. Four months and older, if available, $2 (includes storage fee). Post and packing 60c per issue extra.

OTHER QUERIES: Technical queries outside the scope of "Replies by Post" may be submitted without fee, for reply in the magazine, at the discretion of the Editor.

COMMERCIAL, SURPLUS EQUIPMENT: No information can be supplied.

COMPONENTS: We do not deal in electronic components. Prices, specifications, etc., should be sought from advertisers or agents.

REMITTANCES: Must be negotiable in Australia and made payable to "Electronics Australia". Where the exact charge may be in doubt, we recommend submitting an open cheque endorsed with a suitable limitation.

ADDRESS: All requests to the Assistant Editor, "Electronics Australia", Box 163, Beaconsfield, 2014.

NOTES & ERRATA

1980 ALL-WAVE THREE (April 1980, 4/TR3/7): In the parts list, the Neosid toroid formers should read 4329R/2/F25.

MULTIPURPOSE VOLTAGE REGULATOR (April 1980, 2/PS/50): The 10uF and 1uF capacitors on both the circuit and PCB diagram should be swapped over to agree with applications information from National Semiconductor.

SUPER BASS FILTER (February, 1980, 1/F/13): The PC board pattern supplied to manufacturers has a link missing between pins 6 and 7 of the 14 pin IC pad. This link does appear on all the patterns published in the original article however. The fault is easily rectified by bridging the two pins. Also two earth symbols are shown on the circuit diagram of the power supply on page 43. The earth symbol shown connected to the −12 volt line should be ignored.

DIGITAL CAPACITANCE METER (March, 1980, File No 7/CM/13): The 74C/CD40106 hex Schmitt IC specified in the parts is not exactly equivalent to the MC14584. The 74C14 has a larger hysteresis voltage which is preferable for this circuit. Because of the larger hystersis voltage, the update time for the display is considerably increased. To get reasonable update times, the following changes should be made: the .001uF capacitor at pin 9 of IC1d should be changed to a 390pF polystyrene capacitor; the .0022uF capacitor at pin 8 of IC3c should be changed to .0068uF; and the 680k and 6.8k resistors in the gating oscillator should be changed to 330k and 3.3k respectively.

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R&C Substitution Boxes Cont'd from P68

on the front panel, while the switch wipers are connected to the red terminal posts.

Don't forget to connect the wipers of the two switches in parallel when constructing the tantalum substitution box. Remember, too, that tantalum capacitors are polarity-conscious. They must be wired into circuit with their positive leads connected to the switch terminals.

The decade capacitance substitution box is more difficult to assemble because of the number of physically large capacitors that have to be accommodated. The best approach is to mount the smaller values on the top three switches first. You should try to mount them as close to the switches as possible, so as to leave enough room for the larger values.

The accompanying photograph shows the layout we used, and this should be followed closely.

It's a good idea to provide additional support for the large capacitors by applying a small dab of epoxy adhesive to hold them in place against the front panel. This will eliminate the risk of undue strain on the leads.

Check your work carefully before closing the lid of each box, as any mistakes could lead to a great deal of frustration later on. If you have access to a capacitance meter, then it may be used to check as many ranges as possible.

Well, there you have it — four versatile substitution boxes that should prove useful no matter what your interest in electronics. Build them up and you'll find the effort well worthwhile.

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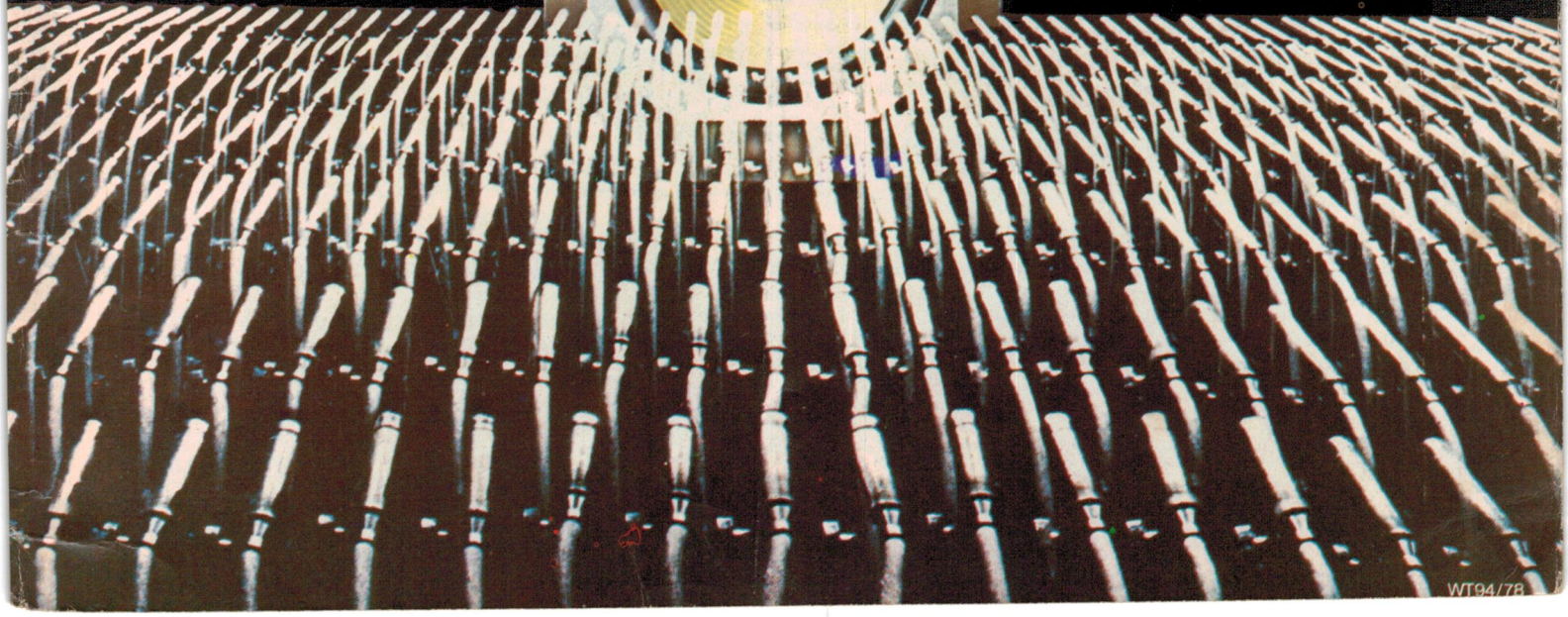

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